SCIENTIFIC AMERICAN

MARCH 1, 1913

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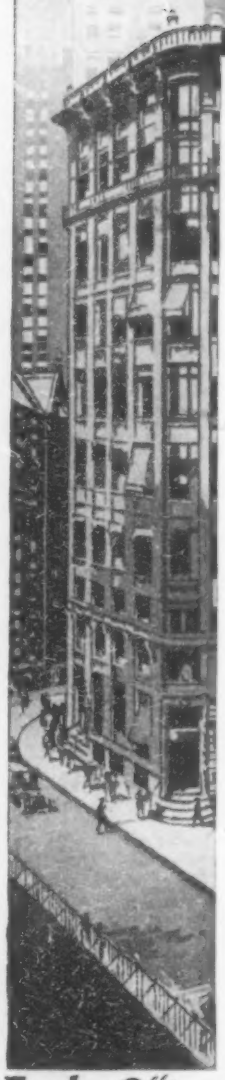

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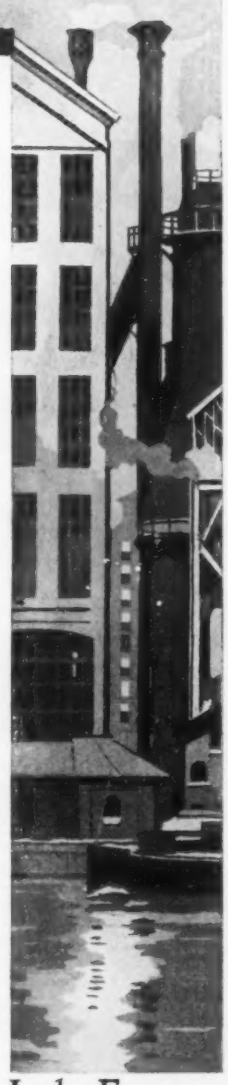

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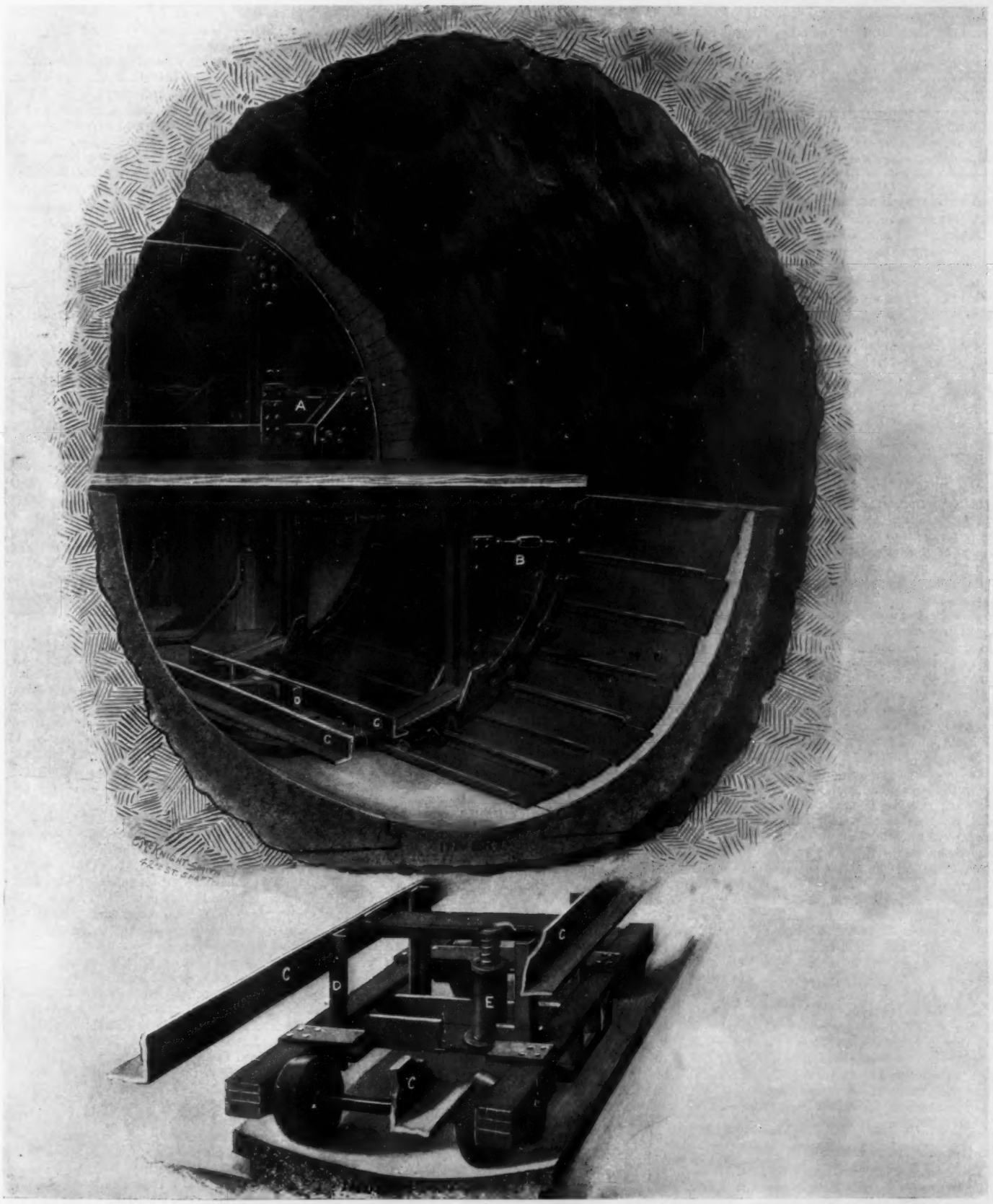

Steel forms used in lining the aqueduct with concrete. The forms are retracted from the lining after it is set, and moved forward on trucks.

SUPPLYING A METROPOLIS WITH MOUNTAIN WATER.—[See page 201.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Naval Reserve Movement

THERE have been few movements of national importance that more vitally affect the interests of this country than the proposal to establish a sea-going naval reserve for the United States. The material for such a reserve is present in abundance. We have heard so much about the decline of our merchant marine, that we are apt to forget that this decline affects the deep-sea trade only, and that the scarcity of American sailors is confined to that branch of the shipping trade. Not many people realize that the tonnage of our coastwise and lake marine is greater than that of the whole merchant fleet of Germany, and that in all probability, not far short of one hundred thousand men are required to man this tonnage. In the coastwise and lake trade, then, the Government can find a field for recruiting which contains material of the very best quality. We entirely agree with our contemporary, the *Marine Journal*, in its conviction that no better sailormen can be found anywhere in the world in their several ratings than the masters, deck officers, engineers, oilers, water tenders, quartermasters, etc., of the large fleet of American steamers sailing from the port of New York and engaged in trade to our own eastern and southern ports, the Gulf of Mexico and the West Indies. From our coastwise shipping, then, it is possible to recruit for the naval reserve men who are skilled, reliable and possessed of that ardent patriotism which goes to the making of good navy sailormen. From the port of New York alone it should be possible to enroll several thousand men for the proposed naval reserve, who, in the emergency of war, might be assigned at once to the auxiliary ships which are necessary to a fighting fleet. Our navy could thus be strengthened at the very point, where it has proved, and may yet prove, to be weakest in the stress of a long-drawn-out naval war. Similar recruiting could be done at Philadelphia, Baltimore, Norfolk, Boston, Portland, Puget Sound and San Francisco. This source of supply concerns only our coastwise trade. To this must be added the fruitful recruiting ground offered by the large body of qualified seamen to be found on the big steamers of the Great Lakes.

The proposal of the Government is to enroll the officers and men of the merchant service; give them the necessary amount of instruction and a reasonable compensation, and thus have at command a large force of trained men, ready at the nation's call. We commend this movement to the hearty co-operation of everyone who can assist in bringing it to a successful consummation. The naval reserve of Great Britain is large, efficient, and full of enthusiasm. The service is extremely popular. Officers and men alike are proud of the distinction of wearing the naval badge, and of the fact that their ships fly the blue flag of the Royal Naval Reserve. There is no reason to doubt that a similar popularity would follow the establishment of a naval reserve for the United States Navy.

Morse Signals from London to New York

THE announcement recently made that Morse telegraph signals were being transmitted direct between London and New York over the lines of a cable company indicates that the chief problem of cable electricians for many years and the goal of endless experimentation and research has perhaps been attained. Furthermore, it is most appropriate that the engineer to whom this accomplishment is due, is one whose life has been spent in the development of submarine telegraphy, and that this successful outcome of a long series of experiments and practical tests forms a fitting climax to a notable career.

Those familiar with manuals of electrical testing will recall such methods as the electro-static capacity measurement of a submarine cable and the condenser method for determining its resistance associated with the name of John Gott, and it is to this distinguished British engineer that we now owe this most recent development, which promises to revolutionize submarine telegraphy and make still more difficult its replacement by wireless. Mr. Gott, now well along in years, is the senior consulting engineer and chief electrician of an important cable company, over whose lines the new method has been used for several months with entire satisfaction to the engineering and operating staff of the company. Beyond the announcement of the success of the new invention and the securing of the rights for its use, no statement of technical or other details has been made; but we are authoritatively informed that the method has been used successfully over the long, or transatlantic, section of the cable for several months, and that the complete line between London and New York has been worked direct. Morse signals, sent by hand as fast as a skilled operator could put them on the wire, have been clearly transmitted, and while automatic transmission at high speed has not as yet been attempted, it is undoubtedly a possibility of the future.

Hitherto the limiting distance for the transmission of Morse or dot-and-dash signals through a submarine cable has remained at about 500 miles, and in practical long distance cable working use is made of a sensitive galvanometer, or rather some modification such as the siphon recorder, to indicate the flow of the current in the cable corresponding to the signals. Obviously, to reproduce the range of the overland telegraph and the ease with which relays and repeating devices could be utilized to link up circuits of practically unlimited length, was no mean task for an inventor, and many a cable electrician has carried on refined and indefatigable researches in this field. But submarine cable working at best is complicated by many considerations that do not apply to land lines, and the use of repeating devices is attended by difficulties realized by few outside of those electricians specially skilled in this department. Therefore, Mr. Gott's discovery is little short of epoch making, and the details of the method and instruments, which we hope shortly to describe, will be awaited with great interest by all. Not only is the future of submarine telegraphy concerned, but also that of radio-telegraphic communication across the oceans. Will it be able to compete with more efficiently operated cables any more than it does with our present land lines?

The Passing of a Great Ironmaster

WITH the death of John Fritz, America has lost a pioneer ironmaster and one of the most distinguished manufacturers in that iron and steel industry in which this country leads the world. John Fritz died at his home in Bethlehem, Pa., on February 13th, at the age of 91, and he has left behind him a name and a record which, in that broad field of engineering in which the activities of his busy and fruitful life was spent, are as honorably known abroad as they are in his native country.

In many ways John Fritz was the typical successful American inventor. Like many before him whose fame has gone abroad in the land, he started life in comparatively obscure surroundings and without any of the great advantages of education and financial competence which have given many of the later inventors and engineers a "flying" start in the race for successful achievement and honorable recognition.

John Fritz's father was German, his mother Scotch, and he was born in Chester County as far back as 1822. He picked up his practical education while working on a farm and, later, as an apprentice in a blacksmith's shop, his apprenticeship dating from the year 1838. From the first, he had a taste for mechanical work, and his biographers speak of his invention of an improved shotgun, which was so efficient that the men of the neighborhood came to the young man eager to have his improvement applied to their guns. In 1844 Fritz went as apprentice to a mill for rolling bar iron which had been built at Coatesville, Pa., and there his ability so quickly asserted itself, that in six months' time he was in charge of the plant as ironmaster. At once he began to introduce improvements into the puddling, heating and rolling of bar iron, with the result that in 1854 he was asked to assist in building the well known Cambria Iron Works at Johnstown, Pa.

Even at that early day the distrust by the workmen of labor-saving devices showed itself, and the imported Welsh puddlers and rolling-mill men fought young Fritz at every turn. He lost his mill by fire, and with it went practically all of his capital. Undaunted, he sought and obtained fresh financial backing, and came back and rebuilt his mill on a larger and more improved plan. Federal recognition of Fritz's genius came during the civil war, and the Government engaged him for the mill which it had established at Chattanooga, Tennessee. Here he manufactured rails and repaired locomotives for the Government.

When the Bessemer method for the production of cheap steel was introduced into this country, Fritz at once realized the enormous value of the process. Fritz, Holley, and Jones at once applied their genius to the improvement of the process; and it was they who laid the foundation of the enormous industries which are now represented by the iron and steel trade in this country.

It is well understood that the re-creation of our Navy was rendered possible only when our ironmasters agreed to take up the manufacture of armor plate and the necessary forging for guns of heavy caliber. In this movement, John Fritz stood foremost, and to him we owe the adoption of the Whitworth processes from England and the French processes of Schneider-Creusot; indeed his Bethlehem plant was the first to take up the manufacture of armor plates in the United States.

Lehigh University owes much to the trusteeship and generous assistance of Mr. Fritz, and Columbia University in 1898 conferred upon him the degree of Master of Arts. He was an honorary member of the American Society of Civil Engineers, was president of the American Society of Mechanical Engineers and also of the American Institute of Mining Engineers. In 1895 he was awarded the Bessemer gold medal by the unanimous vote of the Iron and Steel Institute of England. Furthermore, he was elected an honorary member of that society, at which time there were but five other names carrying that rare distinction. Among these were the Prince of Wales, King Edward of England, and the late Abram Hewitt of New York. On Mr. Fritz's eightieth birthday was founded the John Fritz Gold Medal for achievement in engineering sciences in this country. John Fritz was not more distinguished than he was beloved. The writer well remembers the occasion of the presentation of the Fritz medal to Sir William White, formerly chief constructor of the British navy, and the entrance of the venerable Fritz, rather late in the evening, when the whole audience of distinguished American engineers rose to its feet in loving and reverential tribute to the aged ironmaster.

Indexes in Scientific Books

IT is high time somebody voiced the sentiments of the world at large with regard to the almost universal custom among French scientific writers of publishing indexless books. Few things are more exasperating than a reference-book without an index—unless the contents of the book are self-indexing, in virtue of an alphabetical arrangement or otherwise—and most treatises, in good standing, on scientific subjects serve more or less as reference-books. German and English scientific books are almost always indexed; French almost never. The omission of the index is simply a piece of unmitigated laziness on the part of the author, who deserves to be castigated accordingly. It is unfortunately true that ideal indexes are rare in every language. Some one has expressed the importance of a good index by saying that an author should always make his own index, even if he lets somebody else write his book—and this is hardly an exaggeration. The present writer, who happens to take a particular interest in meteorology, has in mind several cases in the literature of that science, in which the indexes are so badly made that it is usually easier to hunt down a topic in the text than to seek it by way of the index. Davis's "Elementary Meteorology," an otherwise admirable treatise, furnishes a shining example of the kind of indexing that ought to be avoided. After an entry in the index one finds references to a dozen different places in the text, including all the unimportant allusions to the topic in question, as well as the places where it is seriously discussed. It would have been so easy to put the important references in full-face type or italics! On the other hand, the greatest of all works on climatology, Hann's "Handbuch," is very meagerly indexed. This work is rich in the local nomenclature of climate, but one seeks in vain to run down through the index the places in which the author mentions such interesting phenomena as the "pontias," the "Wisperwind," the "calina," and so on. The only large work in any language on atmospheric optics, Pernter and Exner's "Meteorologische Optik," contains no index, and few books stand in greater need of one. However, this case is a striking exception in the German literature of meteorology; whereas in the French literature of the subject one hails with delight the rare case in which a book contains a "table alphabétique" as well as a "table des matières." Doubtless the botanist and the zoologist, the astronomer and the physicist, will eagerly join their meteorological *confrère* in an appeal to French scientific writers for more indexes.

If, besides indexing their books, the French should take to spelling English and German names correctly, then truly the millennium would be at hand.

Engineering

Sanitation at Panama.—Coming after the statement in the press that the mosquito has begun to develop again in great numbers in the Canal Zone, the last report of Col. Gorgas, chief sanitary officer of the Canal Zone, is timely. The tables show that the year 1912 was the most satisfactory of any since work started in 1904. For the month of December the average death rate per thousand among employees was only 7.14 as against 10.42 in 1911, 25.3 in 1908, and 45.73 in 1905.

Block Signals Compulsory.—In its final report to the Interstate Commerce Commission, the Block Signal and Train Control Board made the important recommendation that all interstate railroads should be compelled to adopt the block-signal system. The Board also recommended that tracks be inclosed and laws against trespassing be enforced. From eight to ten thousand people are killed in one way or another on our railroads every year, and a very large portion of these accidents are due to trespassing on the tracks.

Extensive Railroad Construction in the Northwest.—During the ten months which ended October 31st last, a total of 698 miles of railroad was constructed in Alberta, Canada. The *Engineer* draws attention to the fact that, since 1909, there has been an activity in railroad construction in Alberta without precedent in the history of the North American continent. In 1912, the Canadian Northern Railway built 463 miles of new line and the Grand Truck Pacific increased its mileage from 384 to 619 miles.

The Three-million-yard Slide at Culebra.—Another huge slide, the largest that has yet taken place, has commenced at Culebra. The present indications are that about 3,000,000 cubic yards are in motion, and that it will take until the late autumn to remove the material. By that time the water will be in the cut, and the two big dredges, now building, will be on their way to the Isthmus. These dredges, which have a combined capacity of over one million cubic yards per month, should easily keep the cut open when once the water has been turned in.

Launching of the "Aquatania."—The launching of the "Aquatania" of the Cunard Line is set for Tuesday, April 22nd. This vessel is 900 feet long and she will exceed 50,000 tons gross in tonnage. In everything except speed, she will be an enlarged "Mauretania." Her probable speed will be 23 knots. She has been constructed with the same system of longitudinal bulkheads that characterizes the "Mauretania" and "Lusitania," and she has a watertight lower deck, extending throughout her whole length. Her stern frame and brackets weigh 130 tons with the other parts in proportion. The total number of persons she will be capable of carrying is about 4,500.

New Freight Terminal at Long Island City.—A new freight terminal costing $1,000,000 has been planned for Long Island City, which will give manufacturing concerns in that locality close connections with the railroad systems of the country. The property on which the terminal and piers will be located covers several city blocks, and the plans include a huge freight yard with a capacity of about one thousand freight cars. The docks will accommodate the largest ocean-going freighters, and slips will be provided for the largest car floats that are used in this harbor. A belt-line railroad will connect the entire Queens district business section with the terminal.

Provision of Life-boats.—The British Board of Trade has just issued the revised rules for life-saving appliances at sea. A table showing the number of davits which must be provided specifies what number must be carried on vessels of various lengths. Thus, vessels under 160 feet in length must carry two davits. Vessels between 245 and 270 feet must carry six davits. Those of from 360 to 390 feet, ten davits; vessels of from 450 to 510 feet, fourteen davits. Those from 590 to 670 feet must carry eighteen davits: etc. those from 750 to 840 feet, twenty-two davits, and vessels from 940 to 1,040 feet must carry twenty-six davits. The number of life-boats, or approved substitutes therefor, must provide a seat for every passenger. Motor life-boats may be fitted, but their use is not encouraged.

Electrifying the Panama Railroad.—Now that the relocation and reconstruction of the Panama Railroad is completed, surveys are being made for the transmission of power for the electrical operation of the road. Under normal conditions power will be taken from the Gatun hydro-electric plant, which is now under construction; but there will also be a connection with the present steam electric plant at Miraflores. Current will be transmitted at a pressure of 44,000 volts, and at the various points of distribution it will be reduced to the desired voltage for running the trains, for lighting the canal, and for operating the various machine shops and the gates and other appliances at the dams and locks. The railroad tracks will be spanned by the usual bridges for carrying the cables, etc., which will be placed at distances of from 200 to 300 feet, according to the local curvature conditions of the railroad.

Electricity

Novel Use for an Electric Flatiron.—A recent English electrical paper reports that an ordinary electric flatiron was called into playing a new rôle by the resourcefulness of an automobile driver. Being obliged to leave his car in an unheated garage over night, with the radiator and the cooling system of the car full of water during a spell of cold weather, the driver connected the electric flatiron to the lighting circuit and placed it under the car bonnet, where it served to protect the engine from probable destruction from freezing of the water.

Lowering of Resistance by Extremely Low Temperatures.—Recently reported experiments of a Dutch investigator have gone far to confirm the theory that the electrical resistance of all conductors would be reduced to zero by cooling the conductors to the absolute zero of temperature. By boiling liquid helium in a partial vacuum a temperature of only three degrees above the absolute zero was attained. At this temperature the resistance of mercury was found to be only one ten millionth as great as at zero Centigrade.

From Oil Lamps to Electric Lights at a Bound.—Thanks to a proposed harnessing of a small water-power in Yorkshire, England, the people in certain sections of that county seem destined to pass from the primitive candle and oil-lamp epoch direct to the electric light, in an evolution of illuminating methods skipping the use of gas altogether. Gas has never been provided in this section, but now a hydro-electric corporation composed of villagers, including the postmaster and schoolmaster, proposes to utilize the power of a small stream or "beck" to generate electrical energy and sell it at a charge of six-pence per unit.

Uninsulated Aluminium Windings on Electrical Machinery.—In the manufacture of electrical machinery the dissipation of the heat generated in steel coils and armature windings has been improved by using bare aluminium conductors without any other insulation than the film of oxide which forms on the surface of this metal. It has been known that coils wound with conductors of square cross-section cool down about 40 per cent better than coils wound with round wire, because with the round wires the air spaces between the consecutive turns and layers in the windings operate to check the flow of heat. The film-insulated aluminium conductors carry the benefits of using conductors of square cross-section a step further by getting rid of the cotton or asbestos insulation which is ordinarily used. The superior heat-dissipating qualities of these aluminium windings show to special advantage in the construction of lifting magnets which use heavy currents and are frequently called upon to lift hot castings, etc. In lifting magnets, electric car motors, and many other devices the saving of weight is also an important item.

Sewage Purification by Electricity.—Electrolysis as an aid to sewage purification is a rather recent development and much more is to be expected from it. Oklahoma City has installed a plant where this treatment is successfully applied. A slow stream of city sewage is run through flumes between batteries of iron electrodes. A current of 270 amperes and 2.5 volts is passing between the electrodes and, of course, produces considerable electrolysis of the salts contained in sewage. The result of such electrolysis is to liberate a great deal of oxygen and some ozone at the anodes. This active oxygen and ozone oxidizes the organic matter into harmless and unobjectionable products. At the cathode some metallic hydroxides or bases are formed and these assist in coagulating the floating filth. Colloidal particles in fine suspension are also driven to the electrodes and collected in masses large enough to settle. This Oklahoma plant has a capacity of 750,000 gallons every twenty-four hours at a cost of operation of only $2.16. The municipality is now building a plant for the electrolytic formation of a flocculent precipitate, capable of treating 4,000,000 gallons daily.

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A New Hygiene for Gastric Troubles.—Recent cable dispatches from Paris have announced a novel method of treatment for stomach troubles, consisting in exercise taken by the patient while in the position known as "on all fours." Naturally this has aroused more or less derisive comment on the part of the non-scientific but ready-tongued journalists of the day, who have looked upon it as merely another instance in the long list of health fads and fake cures. That it is something more than this is proved by its serious presentation in such a journal as *La Gazette Medicale*, of Paris. The author of the treatment, Dr. Meunier, advises it, not as a panacea, but to remedy a specific condition, namely, the slow or imperfect evacuation of the gastric contents of the stomach, which is, as is well known, one of the most frequent functional troubles in the pathology of the stomach. Among the causes of this is what is known as the "stomachic ptosis," i. e., the stagnation of the mass of food contained in the pouch of the stomach. Dr. Meunier proved by a series of chemical experiments and X-ray photographs of several patients that evacuation of the stomach proceeded with much grater rapidity in this position than in the normal attitudes. The explanation of this is sought in the assumption that in the evolution of mankind, a change has been made from the horizontal to the erect position of the body. The stomach has remained still imperfectly adapted to the new attitude and therefore functions better in that common to our four-footed ancestors before the intricate development of brain and hand led them to stand on two legs so that they might use their hands freely for offensive, defensive and industrial purposes, as well as gain the advantage of increased height and a greater range of vision.

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Naval Reserve Movement

THERE have been few movements of national importance that more vitally affect the interests of this country than the proposal to establish a sea-going naval reserve for the United States. The material for such a reserve is present in abundance. We have heard so much about the decline of our merchant marine, that we are apt to forget that this decline affects the deep-sea trade only, and that the scarcity of American sailors is confined to that branch of the shipping trade. Not many people realize that the tonnage of our coastwise and lake marine is greater than that of the whole merchant fleet of Germany, and that in all probability, not far short of one hundred thousand men are required to man this tonnage. In the coastwise and lake trade, then, the Government can find a field for recruiting which contains material of the very best quality. We entirely agree with our contemporary, the *Marine Journal*, in its conviction that no better sailormen can be found anywhere in the world in their several ratings than the masters, deck officers, engineers, oilers, water tenders, quartermasters, etc., of the large fleet of American steamers sailing from the port of New York and engaged in trade to our own eastern and southern ports, the Gulf of Mexico and the West Indies. From our coastwise shipping, then, it is possible to recruit for the naval reserve men who are skilled, reliable and possessed of that ardent patriotism which goes to the making of good navy sailormen. From the port of New York alone it should be possible to enroll several thousand men for the proposed naval reserve, who, in the emergency of war, might be assigned at once to the auxiliary ships which are necessary to a fighting fleet. Our navy could thus be strengthened at the very point, where it has proved, and may yet prove, to be weakest in the stress of a long-drawn-out naval war. Similar recruiting could be done at Philadelphia, Baltimore, Norfolk, Boston, Portland, Puget Sound and San Francisco. This source of supply concerns only our coastwise trade. To this must be added the fruitful recruiting ground offered by the large body of qualified seamen to be found on the big steamers of the Great Lakes.

The proposal of the Government is to enroll the officers and men of the merchant service; give them the necessary amount of instruction and a reasonable compensation, and thus have at command a large force of trained men, ready at the nation's call. We commend this movement to the hearty co-operation of everyone who can assist in bringing it to a successful consummation. The naval reserve of Great Britain is large, efficient, and full of enthusiasm. The service is extremely popular. Officers and men alike are proud of the distinction of wearing the naval badge, and of the fact that their ships fly the blue flag of the Royal Naval Reserve. There is no reason to doubt that a similar popularity would follow the establishment of a naval reserve for the United States Navy.

Morse Signals from London to New York

THE announcement recently made that Morse telegraph signals were being transmitted direct between London and New York over the lines of a cable company indicates that the chief problem of cable electricians for many years and the goal of endless experimentation and research has perhaps been attained. Furthermore, it is most appropriate that the engineer to whom this accomplishment is due, is one whose life has been spent in the development of submarine telegraphy, and that this successful outcome of a long series of experiments and practical tests forms a fitting climax to a notable career.

Those familiar with manuals of electrical testing will recall such methods as the electro-static capacity measurement of a submarine cable and the condenser method for determining its resistance associated with the name of John Gott, and it is to this distinguished British engineer that we now owe this most recent development, which promises to revolutionize submarine telegraphy and make still more difficult its replacement by wireless. Mr. Gott, now well along in years, is the senior consulting engineer and chief electrician of an important cable company, over whose lines the new method has been used for several months with entire satisfaction to the engineering and operating staff of the company. Beyond the announcement of the success of the new invention and the securing of the rights for its use, no statement of technical or other details has been made; but we are authoritatively informed that the method has been used successfully over the long, or transatlantic, section of the cable for several months, and that the complete line between London and New York has been worked direct. Morse signals, sent by hand as fast as a skilled operator could put them on the wire, have been clearly transmitted, and while automatic transmission at high speed has not as yet been attempted, it is undoubtedly a possibility of the future.

Hitherto the limiting distance for the transmission of Morse or dot-and-dash signals through a submarine cable has remained at about 500 miles, and in practical long distance cable working use is made of a sensitive galvanometer, or rather some modification such as the siphon recorder, to indicate the flow of the current in the cable corresponding to the signals. Obviously, to reproduce the range of the overland telegraph and the ease with which relays and repeating devices could be utilized to link up circuits of practically unlimited length, was no mean task for an inventor, and many a cable electrician has carried on refined and indefatigable researches in this field. But submarine cable working at best is complicated by many considerations that do not apply to land lines, and the use of repeating devices is attended by difficulties realized by few outside of those electricians specially skilled in this department. Therefore, Mr. Gott's discovery is little short of epoch making, and the details of the method and instruments, which we hope shortly to describe, will be awaited with great interest by all. Not only is the future of submarine telegraphy concerned, but also that of radio-telegraphic communication across the oceans. Will it be able to compete with more efficiently operated cables any more than it does with our present land lines?

The Passing of a Great Ironmaster

WITH the death of John Fritz, America has lost a pioneer ironmaster and one of the most distinguished manufacturers in that iron and steel industry in which this country leads the world. John Fritz died at his home in Bethlehem, Pa., on February 13th, at the age of 91, and he has left behind him a name and a record which, in that broad field of engineering in which the activities of his busy and fruitful life was spent, are as honorably known abroad as they are in his native country.

In many ways John Fritz was the typical successful American inventor. Like many before him whose fame has gone abroad in the land, he started life in comparatively obscure surroundings and without any of the great advantages of education and financial competence which have given many of the later inventors and engineers a "flying" start in the race for successful achievement and honorable recognition.

John Fritz's father was German, his mother Scotch, and he was born in Chester County as far back as 1822. He picked up his practical education while working on a farm and, later, as an apprentice in a blacksmith's shop, his apprenticeship dating from the year 1838. From the first, he had a taste for mechanical work, and his biographers speak of his invention of an improved shotgun, which was so efficient that the men of the neighborhood came to the young man eager to have his improvement applied to their guns. In 1844 Fritz went as apprentice to a mill for rolling bar iron which had been built at Coatesville, Pa., and there his ability so quickly asserted itself, that in six months' time he was in charge of the plant as ironmaster. At once he began to introduce improvements into the puddling, heating and rolling of bar iron, with the result that in 1854 he was asked to assist in building the well known Cambria Iron Works at Johnstown, Pa.

Even at that early day the distrust by the workmen of labor-saving devices showed itself, and the imported Welsh puddlers and rolling-mill men fought young Fritz at every turn. He lost his mill by fire, and with it went practically all of his capital. Undaunted, he sought and obtained fresh financial backing, and came back and rebuilt his mill on a larger and more improved plan. Federal recognition of Fritz's genius came during the civil war, and the Government engaged him for the mill which it had established at Chattanooga, Tennessee. Here he manufactured rails and repaired locomotives for the Government.

When the Bessemer method for the production of cheap steel was introduced into this country, Fritz at once realized the enormous value of the process. Fritz, Holley, and Jones at once applied their genius to the improvement of the process; and it was they who laid the foundation of the enormous industries which are now represented by the iron and steel trade in this country.

It is well understood that the re-creation of our Navy was rendered possible only when our ironmasters agreed to take up the manufacture of armor plate and the necessary forging for guns of heavy caliber. In this movement, John Fritz stood foremost, and to him we owe the adoption of the Whitworth processes from England and the French processes of Schneider-Creusot; indeed his Bethlehem plant was the first to take up the manufacture of armor plates in the United States.

Lehigh University owes much to the trusteeship and generous assistance of Mr. Fritz, and Columbia University in 1898 conferred upon him the degree of Master of Arts. He was an honorary member of the American Society of Civil Engineers, was president of the American Society of Mechanical Engineers and also of the American Institute of Mining Engineers. In 1895 he was awarded the Bessemer gold medal by the unanimous vote of the Iron and Steel Institute of England. Furthermore, he was elected an honorary member of that society, at which time there were but five other names carrying that rare distinction. Among these were the Prince of Wales, King Edward of England, and the late Abram Hewitt of New York. On Mr. Fritz's eightieth birthday was founded the John Fritz Gold Medal for achievement in engineering sciences in this country. John Fritz was not more distinguished than he was beloved. The writer well remembers the occasion of the presentation of the Fritz medal to Sir William White, formerly chief constructor of the British navy, and the entrance of the venerable Fritz, rather late in the evening, when the whole audience of distinguished American engineers rose to its feet in loving and reverential tribute to the aged ironmaster.

Indexes in Scientific Books

IT is high time somebody voiced the sentiments of the world at large with regard to the almost universal custom among French scientific writers of publishing indexless books. Few things are more exasperating than a reference-book without an index—unless the contents of the book are self-indexing, in virtue of an alphabetical arrangement or otherwise—and most treatises, in good standing, on scientific subjects serve more or less as reference-books. German and English scientific books are almost always indexed; French almost never. The omission of the index is simply a piece of unmitigated laziness on the part of the author, who deserves to be castigated accordingly. It is unfortunately true that ideal indexes are rare in every language. Some one has expressed the importance of a good index by saying that an author should always make his own index, even if he lets somebody else write his book—and this is hardly an exaggeration. The present writer, who happens to take a particular interest in meteorology, has in mind several cases in the literature of that science, in which the indexes are so badly made that it is usually easier to hunt down a topic in the text than to seek it by way of the index. Davis's "Elementary Meteorology," an otherwise admirable treatise, furnishes a shining example of the kind of indexing that ought to be avoided. After an entry in the index one finds references to a dozen different places in the text, including all the unimportant allusions to the topic in question, as well as the places where it is seriously discussed. It would have been so easy to put the important references in full-face type or italics! On the other hand, the greatest of all works on climatology, Hann's "Handbuch," is very meagerly indexed. This work is rich in the local nomenclature of climate, but one seeks in vain to run down through the index the places in which the author mentions such interesting phenomena as the "pontias," the "Wisperwind," the "calina," and so on. The only large work in any language on atmospheric optics, Pernter and Exner's "Meteorologische Optik," contains no index, and few books stand in greater need of one. However, this case is a striking exception in the German literature of meteorology; whereas in the French literature of the subject one hails with delight the rare case in which a book contains a "table alphabétique" as well as a "table des matières." Doubtless the botanist and the zoologist, the astronomer and the physicist, will eagerly join their meteorological *confrère* in an appeal to French scientific writers for more indexes.

If, besides indexing their books, the French should take to spelling English and German names correctly, then truly the millennium would be at hand.

Engineering

Sanitation at Panama.—Coming after the statement in the press that the mosquito has begun to develop again in great numbers in the Canal Zone, the last report of Col. Gorgas, chief sanitary officer of the Canal Zone, is timely. The tables show that the year 1912 was the most satisfactory of any since work started in 1904. For the month of December the average death rate per thousand among employees was only 7.14 as against 10.42 in 1911, 25.3 in 1908, and 45.73 in 1905.

Block Signals Compulsory.—In its final report to the Interstate Commerce Commission, the Block Signal and Train Control Board made the important recommendation that all interstate railroads should be compelled to adopt the block-signal system. The Board also recommended that tracks be inclosed and laws against trespassing be enforced. From eight to ten thousand people are killed in one way or another on our railroads every year, and a very large portion of these accidents are due to trespassing on the tracks.

Extensive Railroad Construction in the Northwest.—During the ten months which ended October 31st last, a total of 698 miles of railroad was constructed in Alberta, Canada. The *Engineer* draws attention to the fact that, since 1909, there has been an activity in railroad construction in Alberta without precedent in the history of the North American continent. In 1912, the Canadian Northern Railway built 463 miles of new line and the Grand Truck Pacific increased its mileage from 384 to 619 miles.

The Three-million-yard Slide at Culebra.—Another huge slide, the largest that has yet taken place, has commenced at Culebra. The present indications are that about 3,000,000 cubic yards are in motion, and that it will take until the late autumn to remove the material. By that time the water will be in the cut, and the two big dredges, now building, will be on their way to the Isthmus. These dredges, which have a combined capacity of over one million cubic yards per month, should easily keep the cut open when once the water has been turned in.

Launching of the "Aquatania."—The launching of the "Aquatania" of the Cunard Line is set for Tuesday, April 22nd. This vessel is 900 feet long and she will exceed 50,000 tons gross in tonnage. In everything except speed, she will be an enlarged "Mauretania." Her probable speed will be 23 knots. She has been constructed with the same system of longitudinal bulkheads that characterizes the "Mauretania" and "Lusitania," and she has a watertight lower deck, extending throughout her whole length. Her stern frame and brackets weigh 130 tons with the other parts in proportion. The total number of persons she will be capable of carrying is about 4,500.

New Freight Terminal at Long Island City.—A new freight terminal costing $1,000,000 has been planned for Long Island City, which will give manufacturing concerns in that locality close connections with the railroad systems of the country. The property on which the terminal and piers will be located covers several city blocks, and the plans include a huge freight yard with a capacity of about one thousand freight cars. The docks will accommodate the largest ocean-going freighters, and slips will be provided for the largest car floats that are used in this harbor. A belt-line railroad will connect the entire Queens district business section with the terminal.

Provision of Life-boats.—The British Board of Trade has just issued the revised rules for life-saving appliances at sea. A table showing the number of davits which must be provided specifies what number must be carried on vessels of various lengths. Thus, vessels under 160 feet in length must carry two davits. Vessels between 245 and 270 feet must carry six davits. Those of from 360 to 390 feet, ten davits; vessels of from 450 to 510 feet, fourteen davits. Those from 590 to 670 feet must carry eighteen davits: etc. those from 750 to 840 feet, twenty-two davits, and vessels from 940 to 1,040 feet must carry twenty-six davits. The number of life-boats, or approved substitutes therefor, must provide a seat for every passenger. Motor life-boats may be fitted, but their use is not encouraged.

Electrifying the Panama Railroad.—Now that the relocation and reconstruction of the Panama Railroad is completed, surveys are being made for the transmission of power for the electrical operation of the road. Under normal conditions power will be taken from the Gatun hydro-electric plant, which is now under construction; but there will also be a connection with the present steam electric plant at Miraflores. Current will be transmitted at a pressure of 44,000 volts, and at the various points of distribution it will be reduced to the desired voltage for running the trains, for lighting the canal, and for operating the various machine shops and the gates and other appliances at the dams and locks. The railroad tracks will be spanned by the usual bridges for carrying the cables, etc., which will be placed at distances of from 200 to 300 feet, according to the local curvature conditions of the railroad.

Electricity

Novel Use for an Electric Flatiron.—A recent English electrical paper reports that an ordinary electric flatiron was called into playing a new rôle by the resourcefulness of an automobile driver. Being obliged to leave his car in an unheated garage over night, with the radiator and the cooling system of the car full of water during a spell of cold weather, the driver connected the electric flatiron to the lighting circuit and placed it under the car bonnet, where it served to protect the engine from probable destruction from freezing of the water.

Lowering of Resistance by Extremely Low Temperatures.—Recently reported experiments of a Dutch investigator have gone far to confirm the theory that the electrical resistance of all conductors would be reduced to zero by cooling the conductors to the absolute zero of temperature. By boiling liquid helium in a partial vacuum a temperature of only three degrees above the absolute zero was attained. At this temperature the resistance of mercury was found to be only one ten millionth as great as at zero Centigrade.

From Oil Lamps to Electric Lights at a Bound.—Thanks to a proposed harnessing of a small water-power in Yorkshire, England, the people in certain sections of that county seem destined to pass from the primitive candle and oil-lamp epoch direct to the electric light, in an evolution of illuminating methods skipping the use of gas altogether. Gas has never been provided in this section, but now a hydro-electric corporation composed of villagers, including the postmaster and schoolmaster, proposes to utilize the power of a small stream or "beck" to generate electrical energy and sell it at a charge of six-pence per unit.

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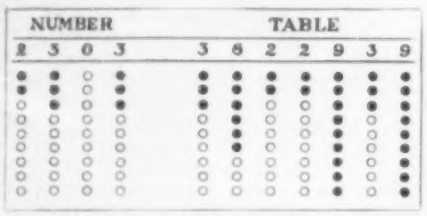
Chlorophyl and Ultra-violet Rays.—A report on the action of ultra-violet rays on chlorophyl has been made to the French Academy of Sciences. MM. C. Dhéré and W. de Rogowski, who have been investigating the subject, find that the pure chlorophyls present a marked relative transparence to the rays of the extreme ultra-violet portion of the spectrum. The natural chlorophyls, in solution in ether, show only a single band of absorption exclusively ultra-violet. This common band is situated in the middle region of the ultra-violet spectrum. This furnishes yet another proof of the biologic importance of ultra-violet rays as affecting vegetation.

Stereopticon Views in Natural Colors.—Following the giving of popular magic lantern shows in natural colors in Paris last summer, which was made possible by the autochrome process of Lumière, Miss Elizabeth Marbury has introduced into this country similiar lantern slides for the purpose of giving "Color Conferences" in which various famous places, paintings, and the like are shown as they really appear. M. André de Fouquières lectures in his native tongue for such as understand his language, and other well-known American artists and lecturers describe the pictures for the benefit of American audiences. M. de Fouquières has lectured on Persia and Versailles, while Mr. Christian Brinton has described Spain, the Alhambra, and the wonderful paintings of Velasquez, Murillo, Titian, Rubens, Van Dyck, and Goya in the Prado at Madrid. The process used in these pictures recently shown in New York is the Gervais-Courtellement. It is similiar in principle to the Lumière process heretofore described in our columns, the only difference being that in place of colored starch grains used as a screen on every plate, microscopic colored bars are employed. On account of the density of the slides caused by this screen, a very powerful 45-ampere arc light is required to project them, and the heat is so intense that there is great danger of cracking if the slide is left in the lantern more than half a minute. The results obtained are very beautiful, whether it be in reproducing paintings and tapestries or scenes from nature such as flowers, sunsets, and autumn foliage.

A New Hygiene for Gastric Troubles.—Recent cable dispatches from Paris have announced a novel method of treatment for stomach troubles, consisting in exercise taken by the patient while in the position known as "on all fours." Naturally this has aroused more or less derisive comment on the part of the non-scientific but ready-tongued journalists of the day, who have looked upon it as merely another instance in the long list of health fads and fake cures. That it is something more than this is proved by its serious presentation in such a journal as *La Gazette Medicale*, of Paris. The author of the treatment, Dr. Meunier, advises it, not as a panacea, but to remedy a specific condition, namely, the slow or imperfect evacuation of the gastric contents of the stomach, which is, as is well known, one of the most frequent functional troubles in the pathology of the stomach. Among the causes of this is what is known as the "stomachic ptosis," i. e., the stagnation of the mass of food contained in the pouch of the stomach. Dr. Meunier proved by a series of chemical experiments and X-ray photographs of several patients that evacuation of the stomach proceeded with much grater rapidity in this position than in the normal attitudes. The explanation of this is sought in the assumption that in the evolution of mankind, a change has been made from the horizontal to the erect position of the body. The stomach has remained still imperfectly adapted to the new attitude and therefore functions better in that common to our four-footed ancestors before the intricate development of brain and hand led them to stand on two legs so that they might use their hands freely for offensive, defensive and industrial purposes, as well as gain the advantage of increased height and a greater range of vision.

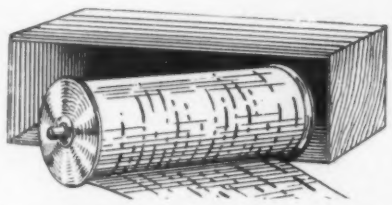


One of the original cards that Babbage used in his "calculating engine"—an invention which was never completed, but which was full of promise.

Keeping Books by Machine

The Punched Card as a Saver of Brain Energy

By H. S. McCormack



By means of electrical contacts made through holes in thin sheets of brass, the most complicated selections can be artistically rendered upon the piano.

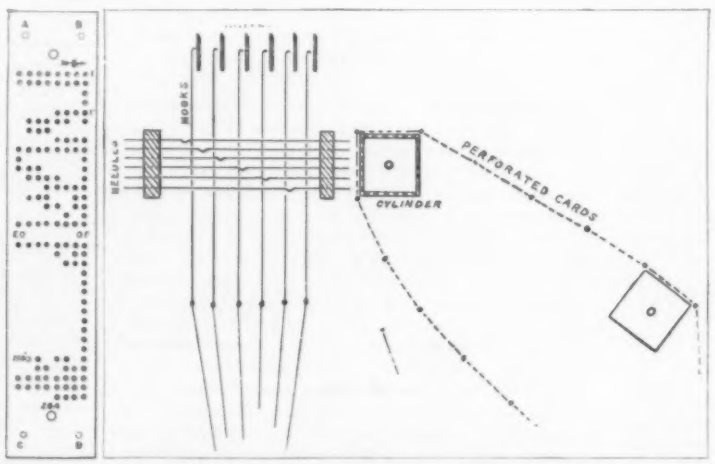
The facts embodied in this article warrant the predictions made by the author and are worthy of serious consideration. Mr. McCormack foresaw present needs by inventing years ago the original typewriter tabulator. He has studied, advocated and applied efficiency by originating and introducing mechanical inventions into accounting and billing and has proved that his insight into these intricate matters has been based not upon theories but fact. The SCIENTIFIC AMERICAN *has arranged for several articles from this author, a recognized authority on efficiency as applied to office and executive management.*—EDITOR.

ABOUT a half century ago, an Englishman named Babbage started work on an invention which is only now nearing completion. He had studied the operation of the Jacquard loom, which through the medium of punched cards weaves designs in fabrics. Holes are punched in the cards to form any design required—no matter how ornate—and the card in turn causes the loom to produce the pattern in many varieties of textiles.

Babbage figured that if punched cards could build designs in textiles there was no reason why they could not be utilized in the same way to make records.

With this idea in mind he built a device which he described as a "calculating engine." He induced Parliament to appropriate £25,000 to further his invention. Unfortunately this money was speedily used up in experimental work and Babbage got no further than a crude handmade and incomplete model of a device he had in mind. Parliament was skeptical and refused to advance more funds, so Babbage was obliged to cease work and the invention was lost to England.

Since Babbage's day the Jacquard principle has been successfully applied to musical instruments, and rolls of punched sheets operate pneumatically the keys of a piano or organ. More recently, through the medium of thin sheets of brass in rolls, an electrical contact is made through the holes, and the most difficult compositions are rendered upon the piano with the crescendo effects and tempo changes of an accomplished musician.



The Jacquard loom, through the medium of punched cards, weaves designs in fabrics. Holes are punched in the cards to form any design required, no matter how ornate, and the card in turn causes the loom to produce the pattern in many varieties of textiles.

How Our Population is Counted and Tabulated With Punched Cards.

Not many years ago the punched card principle was first applied to statistical work in the United States. Its most prominent use has been in its application to census work. In fact, it has always been called "the census machine." Formerly the tabulation of population by States, cities, towns and hamlets; the segregation of the classes, by native and foreign born, male and female, white and black, etc., was performed tediously by hundreds of clerks, with the usual percentage of errors and with little opportunity for securing automatic checks, such as are to-day so vital in correct analysis. In addition, it took about ten years to complete the work. Now it takes ten months.

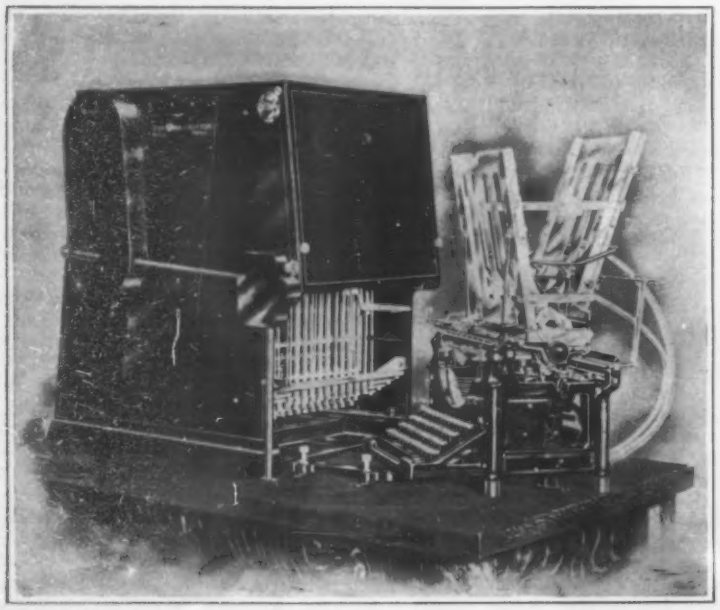
After the Government found this machine so successful in its work, it was adapted to cost accounting and has been used extensively by large firms. Inventors of business appliances began to see that the punched card principle was capable of infinite adaptation, and could perform operations which were previously considered impossible for a mechanical agency to execute.

An interesting example is the automatic typewriter, which actually takes the place of the human fingers for making duplicate letters.

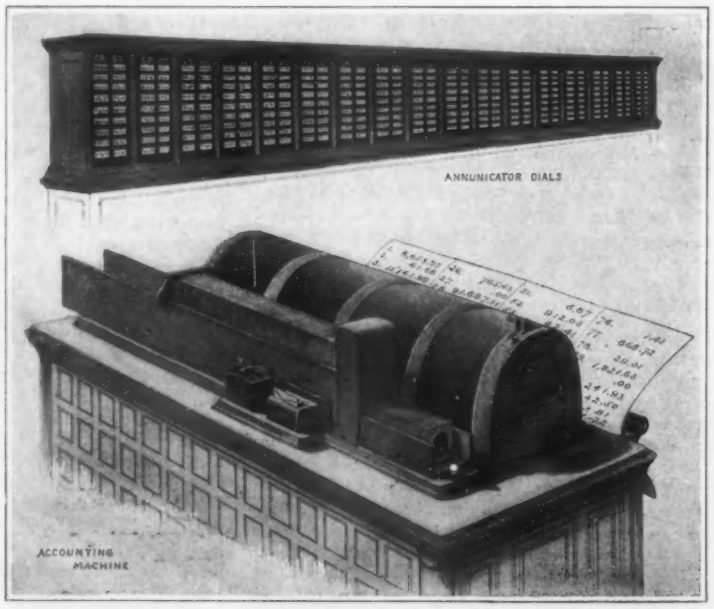
The Player-piano Principle Applied to the Typewriter.

The writer a few years ago journeyed to Detroit, Mich., and inspected a hand-made model of an automatic typewriter operator. Here was employed the same principle—punched holes in rolls of paper—to turn out form letters actually typewritten. At the time of the examination the hand-made model was a very crude affair of the "soap-box" variety, but the principle embodied in the model made it a commercial possibility. One of the leading manufacturers has taken the device under his control, and developed it to a point of practical usefulness. It is almost impossible to recognize the finished product as an evolution of the crude handmade model produced by the inventors. The device to-day is supplied with a quantity of letterheads and the electrical current turned on; through the application of the pneumatic principle, the machine automatically picks up a letterhead and places it in the carriage of the typewriter. The letter is spaced forward to the date line, and the typewriter begins to operate as though actually under the impulse of human hands and fingers. The typewriter carriage moves to the right, and the name, address and salutation are properly placed on the left of the letterhead.

Moving from space to space—the keys being depressed and the type bars flying up and down—there is something almost uncanny in the operation of the typewriter as it proceeds step by step to turn out a complete typewritten letter. The completed letter is removed automatically, with no human hands near, and another letter is started. The name, address and salutation are automatically changed and the operation repeated, letter after letter, until the machine automatically stops. Approximately four hundred duplicate business letters a day can be typewritten by this machine.



The automatic typewriter takes the place of human fingers. It uses a punched roll of paper like a player-piano. By the application of the pneumatic principle the mechanism operates as though actually under the impulse of human hands and fingers.



Some day we will have a ledger cabinet, showing debit and credit dials, operated by cards. Clerks will be supplied with cards already punched with their own number, also the number of their department. When a sale is made they will punch and not write the amount as they do now.

Now comes what seems the most wonderful application of the punched card principle—that of mechanical bookkeeping and business recording—almost replacing the human brain in its performance, and indeed outdistancing it in accuracy. Through a prearranged plan, four business men recently met: one a railroad official from a distant city, another an official connected with one of the country's leading industrial corporations, the third an official of the greatest textile company, while the fourth was the president of a concern of international reputation.

These men were brought together for the purpose of considering at a private demonstration a mechanical marvel which was the result of years of study, hardship and ingenuity on the part of an inventor assisted by mechanical experts whose experience qualified them to carry out the plans of the inventor. The result of years of painstaking effort, trials and disappointments, costly experiments and the expenditure of thousands of dollars could all be shown in a few moments. A few minutes demonstration does not, in this particular case, mean that these men, who were authorities in their fields, understood all they saw. What they beheld in actual operation was almost incredible. Although they were prepared in advance to see certain results accomplished, they could not grasp in less than an hour the details of a principle that will radically affect methods of mechanical accounting.

When these men met at the appointed hour and place, a waiting taxicab whirled them to a section of the west side of New York, which was totally unfamiliar to them. Arriving before a large loft building, the guide led the little party to a machine which accomplished what was heretofore possible only by human intelligence.

That machine performed the remarkable feat of recording approximately eleven entries of a single transaction—eleven entries which would ordinarily have to be made with a pen with eleven chances of making a mistake. In recording a sale, the amount is entered upon a sales check, to be entered upon a bill, again upon the segregated sales record, again into the sales ledger, through another operation placed to the credit of the sales person, then to some department, in addition to a record as to whether the package was delivered by mail, carried away or sent by regular delivery or express. Instead of this constant juggling with the same figures through a maze of operations there will be an original entry upon a punched card, and this card will, through the medium of motor-driven machines, be automatically sorted into various divisions and subdivisions, and recorded item by item upon counters or wheel sets into adding mechanisms.

Prediction of the Mechanical Ledger.

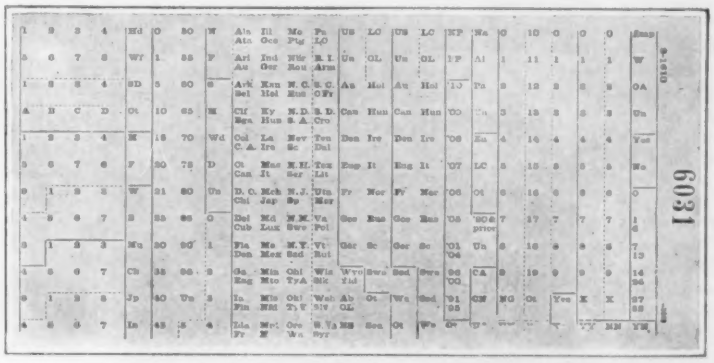
The ledger cards for the A and B ledger will be placed into a machine, the current will be turned on, and with the sales checks in the magazine, the machine will pick out the ledger card of Adam Aaron, and from the magazine pick out the sales check of Mrs. Aaron and will debit the account with 13.73, and at the same time add the amount into the total register. After the ledger postings are complete, the sales checks will be passed through the machine again and listed according to departments. When the department totals are secured, the sales checks will be sorted and listed according to sales persons. At the completion of each sorting, the machine will automatically throw a lever and start the printing mechanism, which will deliver to the operator a printed adding machine list showing the items according to the desired segregations.

As the checks are received in payment or part payment of accounts, the entry will be punched upon a card, the ledger sheets will again be returned to the machine, and in red upon the ledger sheets will be printed the credits. Automatically the amount paid on account will be subtracted from the debit, and the balance, or amount remaining unpaid, will also be printed upon the ledger sheet.

The same principle will be applied to pay rolls; in other words, the laborious accounting of to-day, the repeated juggling of the same figures into the various combinations necessary to analyze a business scientifically, is to become a thing of the past.

If firms could eliminate half of the expense in their accounting departments, losses would be turned into profits and companies who have never paid a dividend, and those who have failed to pay ordinary dividends, would immediately be classed among the successful dividend-earning companies.

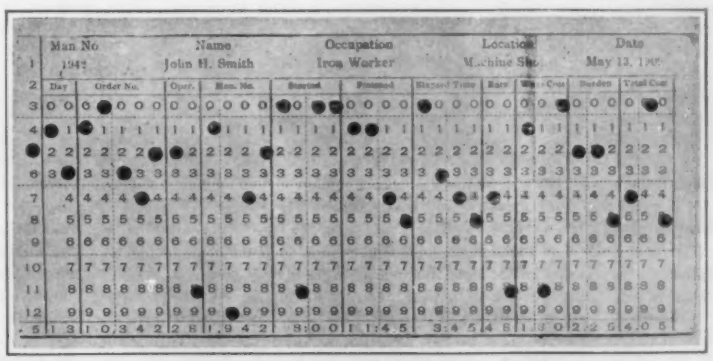
An understanding of the principles described will convey to the reader something of what these four men saw in operation. They saw entries of sales placed upon cards half the size of an ordinary playing-card. They saw when the entries were typed that underneath the figures were small round holes. The number of the department, customer's number, clerk's number, amount of sale, and other details, according to requirements, were entered upon these small cards. A thousand cards were placed into the magazine of the machine and the current turned on. The machine itself was one hundred adding machines worked into an integral whole. A part of the mechanism was one hundred wheel sets, upon which were being accumulated these various amounts. If the machine picked up a card for Department 12, whatever amount had been punched upon this card was properly recorded upon wheel set 12.



By means of such cards the United States Census Bureau tabulates the population by States, cities, towns and hamlets. The work, once performed in years by hundreds of clerks, with many errors, is now performed in ten months.

A machine in use by the Census Bureau.

When the machine finished sorting all the cards a lever was thrown, and automatically a printed strip appeared which was identical in appearance with the printed strip secured from a listing adding machine. The printed strip gave the results of Departments 1, 2, 3, etc., up to 100, and opposite each department was set down the amount sold. Then, as a grand *finale*, the machinery clicked, a number of levers arose, and there was printed one grand total showing all amounts which had been segregated to the various departments, all grouped into one grand total.



The punched card principle applied to the keeping of a mechanic's account. This card has only to be run through a machine in order to obtain a printed statement of the man's output, time, and wage.

A Further Application of the Jacquard Principle.

There is possible a still further application of the Jacquard principle, and inventors will no doubt get to work to apply the same principle to addressing machines. An ordinary card index will be used. The name of John Jones, 261 Broadway, New York City, will be written upon a 3 by 5 card, while underneath the name and address will appear numerous perforations. The cards will be very inexpensive and can be utilized for follow-up or for regular customers, pay roll, etc., and no expensive machinery will be needed to make up new stencils.

There is nothing but common sense in all this. To illustrate: Some four thousand years ago, a method of laying bricks came into practice, and this same method was handed down from generation to generation until very recently. Now, a disciple of Frederick Taylor—Gilbreth—has changed the general order of things and reduced the number of wasteful operations, until to-day a bricklayer with less effort can lay double the number of bricks. Gilbreth did not discover any new principle. He simply applied common sense to a well-known principle and applied it to mortar and bricks instead of tools and steel.

In almost every business house in the country some parallel case can be brought to light by an efficiency engineer when making his examination.

It is common to find a business firm applying efficiency to the order, requisition and billing while totally ignoring the same principles which could be applied to their voucher system with equal results in saving of time and expense. On the other hand, a department store with appliances and systems of various kinds will retain in its purchasing department an antiquated method for requisitions, simply through failing to see that the same ideas used so effectively in other directions are really a principle which, when combined with a little common sense, go far toward reducing friction and promoting efficiency.

The Pneumatic Typewriter.

Now an inventor is working upon a principle where phonetic *sounds* can be recorded upon *strips of paper*. A man, for example, will call in his stenotypist, who will have this small device instead of the old-fashioned note book and pencil. The little device will be a phonetic writer which will punch little holes in a strip of paper. These strips of paper will be fed into an automatic typewriter, which will typewrite the words as the punchings in the strip will bring into play certain cards which will allow the machine to write the proper combinations.

Thirty years ago business houses had copyists who laboriously wrote pen-written letters, but to-day the stenographer fills the place. Twenty years from now bookkeepers, as they are known to-day, will be as great a curiosity as copyists are. In their place will be entry clerks of known ability, and accountants who will take the machine-produced figures, and through the medium of graphic charts, will present to the heads of departments a record of the previous day's business with comparative records by weeks, months and previous years. By ten o'clock each morning the record sheets dealing with vital totals will be placed upon the desks of the officials, who will then be in a position to keep their fingers upon the pulse of the business at all times.

There was a time, only fifty years ago, when a large majority of small businesses were run on the cash drawer and hip-pocket principle. Conditions improved; the business men wanted a balance struck off at the end of the year. It was followed by the semi-annual inventory, after which the more progressive wanted a balance sheet every month.

Finally came the weekly report, while in some offices the daily report has arrived. But with increased competition, improved machinery and a reduction in overhead expense, and through the introduction of efficiency, the average business man, instead of delving into ancient history, a month old, will be able, after reading the latest quotations in the morning paper, to pick up his own balance sheet and know the latest quotation that his business has placed upon his ability.

With mechanical ledgers somewhat resembling telephone switchboards, bank clerks will punch cards as deposits are received or withdrawn.

Tests of German Aeronautic Motors

OF the forty-five representative German aeronautical motors which were entered in the competition for the 50,000 mark prize offered by the Kaiser for the motor which should make the best showing in a series of tests conducted by the German government, which competition was held on the Kaiser's birthday, January 27th, 1913, but nineteen lasted through the series of tests. Of the nineteen, the best showing was made by the Benz motor—a four-cylinder creation rated at 100 horse-power—designed by Chief Engineer Berger, and it emerged from the contest with a tally of 355 points against 370 which were chalked up for poor performance against the nearest competitor. The other four prizes offered—30,000 marks by the chancellor, 25,000 marks by the minister of war, and 10,000 marks each by the secretary of the navy and the secretary of the interior—were awarded to the makers of the 90 horse-power Daimler, 95 horse-power N. A. G., 72 horse-power Daimler and 70 horse-power Argus, respectively. The scores of these four contenders were 370, 402, 406 and 450 points, respectively.

The conditions imposed and the tests to which the motors were subjected were calculated to compare the motors with regard to their all-around efficiency for the service at hand, and to this end one of the conditions was that the entire motor must be assembled on the spot within a time limit of three days; one of the tests necessitated that the motor be sufficiently light to permit the plane in which it was mounted to coast or glide with the motor at a standstill for 15 minutes after the plane had been elevated for an equal interval, the elevating plane being fifteen per cent. In full the tests were: After erection within the three-day time limit, the motors were subjected to a half-hour preliminary test, running under full load on the block.

Mounted in an aeroplane, the motor was run under full load for fifteen minutes and the plane guided so that it mounted a fifteen per cent grade; the motor then was stopped and the plane guided to earth, it being necessary for it to glide for fifteen minutes.

The motor was then run for seven hours without stopping.

The plane was then driven in horizontal flight for three hours, and after a stop of not half an hour, another two and one half hour flight was indulged in.

The final test consisted in running the motor at top speed for half an hour.

The prize winning motor was possessed of four individually cast cylinders with overhead valves; bore and stroke were 130 and 180 millimeters, respectively, and the power developed was, as before stated, 100 horse-power at 1,250 revolutions a minute. When speeded up so that the crankshaft speed was 1,380 revolutions a minute, the power was correspondingly greater. In the design of the motor no efforts have been spared to obtain reliability, as is evidenced by the duplication not only of the ignition system (two separate and distinct magnetos operating on separate plugs positioned in opposite sides of the cylinders were employed), but of the water circulating pump and the oil circulating pump as well.

By way of reducing the weight to the very last degree, the cylinders are formed of a special iron alloy, more easily worked than steel, and at the same time more durable under the conditions. The cylinder jackets are of pressed steel and are sweated into place.

During the tests the gasoline consumption was but 210 grammes per horse-power hour, considerably less than that required for the operation of the average automobile motor. This showing is due in part to the arrangement of the intake manifold which is triple branched and innocent of sharp bends calculated to occasion banking of the mixture, and in part to the peculiar construction and location of the carbureter. The latter, or at least the larger portion of the latter, is cast integral with the crankcase so that it is in reality a part of the motor and not an appendage. The location has much in its favor, since it not only economizes room and permits of a very compact construction, but also eliminates projecting parts to a greater or lesser degree and provides a support for what would otherwise be a free end of the manifold, tending to eliminate vibration and strain on the manifold bolts. Moreover, as the air inlet leads from the inside of the crankcase, the air supplied is heated so that a more homogeneous mixture is obtained. Air is admitted to the crank chamber through a valve provided with a protective screen.

Circulation of the cooling water is induced by a generously proportioned centrifugal pump driven from the cam-shaft. A second pump of similar construction is provided for emergency use, and is driven by means of bevel gears from the magneto drive shaft. Careful balancing of all of the component parts, both statically and dynamically, has resulted in the production of a motor which is singularly free from vibration at all speeds. The weight of the motor, including all piping and fittings is but 153 kilogrammes.

Wind-rolled Snowballs

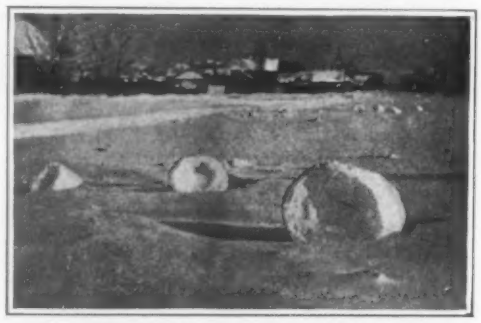
"ONE of the strangest pranks of wind and snow was witnessed by residents of Davenport, Washington, the afternoon of January 17th, when a strong gust of wind from the southeast blowing for a period of a minute and a half rolled thousands of snowballs from a particle of snow to big ones large as ordinary barrels and resembling in every respect huge rolls of cotton batting. A peculiarity of the unheard-of prank of nature was the fact that nearly all the rolling was up hill, every south slope for miles being covered with the balls. An inch of snow of the right consistency

A group of snowballs rolled by the wind.

had fallen on a hard crust of snow and made possible this peculiar phenomenon." The photographs and this brief description were supplied by Edward H. Page of Davenport, Washington.

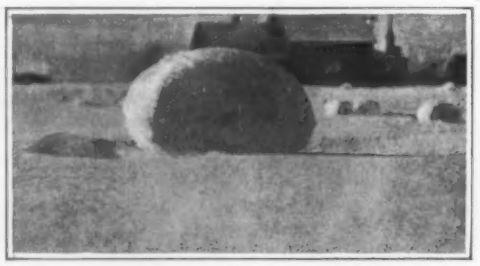
By an odd coincidence a similar freak has just been reported to the Editor by T. J. Moon of Middletown, N. Y. He writes:

"At the town of Potsdam, N. Y., on the 29th of last December, occurred a light, but very sticky fall of snow, accompanied by a light wind which blew at right angles to the crest of a slight hill, on the lee side of which were found the snowballs which are seen



View showing the concave ends of the balls.

in the pictures. The wind had evidently picked up a wisp of snow, rolled it along, as a boy does, to make a snow man, and as they rolled, the size of some reached a diameter of over two feet; the concentric layers of added snow could be easily seen, in fact, they show in the print of one taken at close range, also the trail left as the snow picked up, is plainly visible. There were over fifty of these wind-rolled snowballs in our yard alone, and a few near by, where conditions were similar, but in all the experience of the 'oldest inhabitant'



A nearer view of one of the balls.

no such peculiar occurrence had transpired before, and I have never heard of the like, so thought it might be of interest. A peculiar fact was that the rolls of snow were concave at the ends, like the vertebra of a fish, showing the size of the small bit of snow first picked up at the crest of the hill, and indicating that the increase had been in length as well as diameter."

A New Way of Studying Soils

"NO industry is so vital to the well-being of a nation as agriculture, and nothing is so vital to agriculture as the soil. From its treasury it has been estimated that we drew during the year 1909 more than $8,296,000,000, and its possibilities are as yet only partially realized. There are still in this country millions of acres which have never felt the plow, while those which are now under cultivation can, by the application of scientific principles, be made to produce many times the present value of their products. How to use and not abuse this great resource is the most important problem which faces the farmer of to-day—one worthy of the best efforts of our most profound and learned scientists; for upon its solution depends the future prosperity of the nation."

This statement from Bulletin 85 of the Bureau of Soils relating to the soils of the country. While a comparatively small percentage of the soils of the United States have been surveyed and analyzed by the department, more than 800 types of soils have been discovered during the progress of the soil survey. The existence of such a large variety of soil types, each possessed of definite and peculiar characteristics, calls attention to the importance of a careful study of the soils and their relation to agriculture. The Bulletin says:

"The old idea of soil investigation was to collect samples, examine them in the laboratory, and see what differences could there be determined; the newer idea is to study the characteristics and properties of soils in the field, classify them according to obvious differences, and, with this information in hand, use the laboratory as a means of ascertaining the cause of such variations as cannot be determined in the field. This method of attacking soil problems is the reverse of the usual practice, but because of the great difficulty in duplicating field conditions, it is believed that a field examination should precede laboratory studies. The field observations can thus be used as a check upon laboratory investigation, and as an aid in their interpretation. Field studies furnish a safe and necessary anchor with which to keep the laboratory experimenter from being dashed against the rock of pure speculation. The classifying and mapping of the various soil types, together with the study of the conditions and processes under which they have been formed, will furnish essential and invaluable data for the conduct of laboratory investigations. Nature's great laboratory is in the field, and a study of her methods cannot fail to offer many valuable suggestions, and, in some cases, is the only means of solving her problems. It is through a combination of field and laboratory investigations that an understanding of this extremely complex body—the soil—can be reached."

The Bulletin treats exhaustively of the soils, their origin, formation and best treatment for agricultural purposes, the great difference between the many types, and adds:

"Since the soil varies so much as regards both its inorganic and organic constituents, marked differences in character must necessarily result from the almost indefinite number of combinations which may be found. All these differences, however, may be traced to two sets of factors: First, the character of the rock or material from which the soil has been derived; and, second, the processes or agencies by means of which this material has been changed from mere rock or rock debris into a medium suitable for the growth of plants. The former has to do with soil-forming material, the latter with soil-forming agencies. To these two groups of factors are to be attributed the numerous variations in soil conditions found over various parts of the earth.

"The importance of distinguishing between these two groups of factors cannot be too strongly emphasized. The tendency in the past has been to stress the former to the neglect of the latter, and this has resulted in classifying together soils of very dissimilar character, simply because they were derived from the same rocks or from rocks which have been formed in the same manner."

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT Prof. W. E. Plummer speaks in the highest terms of the valuable contributions to knowledge which have been made by amateur astronomers.—Prof. Joly, in a most interesting article, tells us how nuclei of radio-active material have in the course of long geological ages produced halos in the rock containing them, by the emission of disintegration products. These halos are of perfectly definite dimensions, and display many remarkable features. They have, moreover, a definite bearing on the moot question of the age of the earth.—James Pattison, in an illustrated article, tells us of the life buoys and light ships of New York harbor.—Dr. Ferranti, in delivering his James Watt lecture on the subject of Prime Movers, made some remarkable comments on the scope and limitations of the Diesel engine. This lecture is reproduced in the current issue.—Within easy access from New York city some remarkable features of the new water supply system are being worked out at the Kensico reservoir. These are described in an illustrated article.—E. N. da Andrade reports on the latest vacuum pumps, which far exceed earlier forms in the low pressures attainable.—Dr. H. E. Hollingworth writes on Experimental Psychology in its relation to medicine.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Prize for a Gasoline Substitute

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to direct attention to an error in proofreading which has crept into my story appearing in the current issue of SCIENTIFIC AMERICAN and entitled "A $100,000 Prize for a Gasolfne Substitute." Please note that the British Society of Motor Manufacturers and Traders has offered a prize of $10,000 and not $100,000 for a gasoline substitute. As stated in the fifth paragraph of the article, it is the International Association of Recognized Automobile Clubs that has offered the $100,000 prize, the grand total therefore being $110,000.

STANLEY PETMAN, M.E.

Brooklyn, N. Y.

Patent Office Fees

To the Editor of the SCIENTIFIC AMERICAN:

As a constant reader of your paper and one who is much interested in inventors and the welfare of the patent system, I beg this space to briefly express my views on the question of increasing the fees for patent applications with especial reference to the article in your paper of February 8th, 1913. In this article you refer to the tremendous sum which has been earned by the Patent Office out of fees and turned into the Treasury. This is interesting, but so far as its effect on Congress is concerned in seeking additional appropriations, it is "a last year's bird nest," as Congress is looking to results at the present time. Now, as a matter of fact, I agree with the proposition that the Patent Office should not be judged by the profit it makes and am convinced that the benefits of the patents to the country at large are so great that inventors should be encouraged to the extent of large contributions from the Federal Government. But can we get the legislators to this view? I fear not. We must not only point to past profits, but we must definitely estimate future ones. Now as to your suggestion that the fees should be reduced, you doubtless are aware that the Economy Commission recommended an increase to $50 while the bill introduced by Mr. Bulkley and now on the calendar of the House of Representatives provides for an increase of the filing fee to $20, making a total of Government fees of $40. Suppose, however, the Government filing fee of $15 should be reduced even $1, what would the result be, based on the report of the Commissioner of Patents for the year ended June 30th, 1912. The net surplus for that year is given as $68,-147.20. The number of applications for patents filed that year was 79,747, so that if the filing fee had been $1 less, there would have been a net loss of nearly $12,000 instead of a surplus. Let our hopes be for better and prompter service by the Patent Office instead of for lower fees.

CONSTANT READER.

A Correction

To the Editor of the SCIENTIFIC AMERICAN:

In the composite price list of American cars, published in the January 11th issue of SCIENTIFIC AMERICAN, you published some erroneous figures with reference to the prices on Packard cars.

Your Packard figures include a "25" roadster at $950, an "18" touring car at $2,800, and a "30" touring car at $3,700. We manufacture only maximum service cars, and you are doubtless aware that it would be impossible for anyone to market such vehicles at the prices named and remain long in business. Our line of motor carriages consists of a "38" at prices ranging from $4,150 to $5,400 and a "48" at prices from $4,650 to $6,100.

The inquiries which we have received since the appearance of your price list speak well for your circulation but are causing us serious embarrassment. We feel confident that your own sense of fairness will induce you to correct the erroneous impression which has been created among your readers.

PACKARD MOTOR CAR COMPANY,
F. G. EASTMAN, Advertising Department.

Detroit, Mich.

Aeroplane Design

To the Editor of the SCIENTIFIC AMERICAN:

One of the most important and at the same time one of the most intricate problems of the aeroplane is the proper shape for the supporting surfaces. The cut-and-try method of testing in vogue at the present time has been the means of supplying a deal of valuable data; but, as will be readily understood, with the most delicate instruments for measuring the air pressure, and with the utmost care in the reading of these, the method can give only approximate results, and is therefore inadequate to the present need of a designer.

In place of this arbitrary and wholly artificial means of testing, the writer would direct the consideration of those interested in the practical development of the aeroplane to another, which in addition to the advantage of giving exact results, is simple and direct.

If a rectangular piece of silk be suspended in a gentle current of air, it takes a curved form as the result of the two forces which act upon it. These forces are (1) its weight acting vertically downward with a pressure equal in intensity at all points on the surface, (2) the pressure of the air. This latter force is horizontal in direction at the extreme front edge of the silk, but, just as the air flows beneath the fabric, it is deflected slightly downward as a result of its reaction with the surface. This downward movement of the air particles is communicated to the air below not immediately adjacent to the silk. The upward component of the pressure of the air consequently diminishes, with the result that more and more surface is exposed to maintain the equilibrium.

In the above experiment, for the sake of clearness, we have dealt only with the air below the silk. The same method of reasoning is equally applicable to the upper side. The air streams are flowing horizontally at the front edge; immediately behind it they are pulled downward by the displacement caused by the cross section of the arc. This pull downward is a pull upward for the plane. The air would now flow parallel with the surface, and would exert no further lift whatever were there no further curve in the surface; but the flexible silk automatically adjusts itself by means of its weight, falling and increasing the cross section until the balance is restored.

We would emphasize then, the fact that the curve taken by a flexible surface of uniform weight suspended freely by one edge in a current of air is a graphical representation of the two forces which act upon it, and that at all points on the surface the two forces are in equilibrium. Also, that for the particular conditions under which the experiment is conducted, the balance is maintained with a minimum of drift, for there is of course a decrease in the absolute drift component of the air pressure, proportional to the decrease in the absolute lift.

The application then of the method of the experiment, as a system of aeroplane supporting-surface graphing, is obvious, for weight balanced by air pressure is a condition identical with the principle underlying the operation of the aeroplane.

A rectangular piece of stout fabric of the actual width to be employed in the construction of the machine itself could be suspended by one edge in a wind tunnel, and the load, that is weight per square foot of supporting surface, distributed uniformly over the whole area by passing flat metal bars through loops in the upper side of the fabric. By placing these parallel with the front edge, and by spacing them short distances apart, the surface would be entirely flexible, free to take up the position in which its own weight would balance the reaction of the air upon its surfaces. This position could be fixed photographically and the pattern thus obtained used for the construction of a rigid plane.

Such a method undoubtedly would be of incalculable use to a constructor, for not less important than the facility of the system is the interchangeability of the elements involved. As to the question of the angle of incidence, it will be readily seen that this could be adjusted as desired in either or both of two ways: by altering the load or by changing the relative speed of the air. Thus, a designer would be enabled to produce the most efficient wing form for any possible combination of flight conditions.

It is interesting in this connection to notice the high degree to which the above principle has been carried in the structure of that bird of the water, the sailing vessel, whose wing, automatically varying to the most favorable form under any conditions of wind pressure, and direction of wind pressure, can propel the craft almost into the teeth of a wind. In fact, no better proof of the practical worth of the idea suggested could be wished for than this, that no rigid surface, plane or curved, has been found to give the all-round efficiency of the flexible sail.

It seems probable even that with proper observance of the perfection of detail required in the design of aerial vehicles, substantially the same method of leaving the fabric flexible might be applied with interesting results to the construction of an aeroplane's wings. However, it seems probable that, as in both classes of vehicles the best efficiency could only be obtained by altering the length of the chord, the best way would be, as is the present practice, to construct the machine rigid and designed for the highest speed the craft is meant to attain, since it is of course at the maximum speed that exquisiteness of design is most required. Moreover, the rigid structure would seem to be particularly adapted to the aeroplane, since full speed when once attained is as regular as that of the highest types of automatic machinery.

For the verification of the conclusions reached in the preceding, the writer would point out that the curvature taken by the surface in the experiment is a modification of one of the conic sections known as the semi-parabola; and would refer to the fact that this curve is universally acknowledged by mathematicians and has been experimentally proved to be the basic curve for wing sections. Indeed, it would be a comparatively simple matter to plot the curve for any combination of weight and horizontal pressure, were it not for the fact that the action and reaction of the particles in a fluid are exceedingly complex and consequently considerably modify the result. It is in overcoming this difficulty that the method outlined above should prove so effective.

Bowmanville, Ont. GRANT LINTON.

Are Levees a Failure?

To the Editor of the SCIENTIFIC AMERICAN:

All rivers subject to floods, if they flow through flat lands, form a sort of natural levee. This process is going on at my office door on the east bank of the Greenbrier River, on a small scale. When the river is in flood the plain on this side is covered with water. Where the rapid current of the river comes in contact with the more quiet water on the plain or bottom land and is checked by it, a line of sediment is deposited, thus forming a natural levee. Left to nature, the river bed, the bottom land, and the natural levee rise together, keeping a sort of relation to one another. If you build an artificial levee, you interfere with this relation; and as the bed of the river rises by sediment, you must keep on adding to the height of the levee until in time the bed of the river will be above the country around; because the flat country not getting its proportion of deposit does not rise as it did before the levees were constructed by man. Now to some extent the artificial levees make more current and keep the deposit from forming so rapidly in places; but it makes the condition worse in others, when current is sluggish. From this theory the remedy would be to control the flood waters about the heads of the streams by dams. No large river has ever been successfully leveed, nor ever will be, for the reason given. The attention of people living along rivers subject to devastating floods should be called to this scientific fact.

Marlington, W. Va. J. W. PRICE, M.D.

The Spring Wheel

To the Editor of the SCIENTIFIC AMERICAN:

Referring to letter from Mr. G. F. Fischer in your issue of February 1st under the title of "The Fallacy of the Spring Wheel," it would hardly be fair to the automobile world to allow a conclusion so erroneous to go unanswered.

The basis from which your correspondent reasons implies that there is but one kind of spring wheel and that that kind is of the crudest and most imperfect form of wheel. The only arrangement that he indicates is one in which the springs at the top of the wheel and those at the bottom of the wheel carry the load and he practically assumes that there is no other method of creating a spring wheel. Having started out from an erroneous basis he must necessarily reach an erroneous conclusion.

Everyone in the least degree familiar with the spring wheel art knows that any radial arrangement of springs by which the springs at the top and bottom of the wheel carry the load chiefly, or any arrangement in which the load is passed from one spring to another or from one series of springs to another is a long ways behind the present condition of the art.

Further, anyone who has studied the question and kept *au courant* with the art is familiar with the fact that the highest type of spring wheel requires all of the springs to assist equally at all times in carrying the load and in meeting the shocks, and further that in the highest type of spring wheel when the wheel is operated over a perfectly level road the springs are not flexed in the least degree, but remain stationary just the same as the eliptical spring.

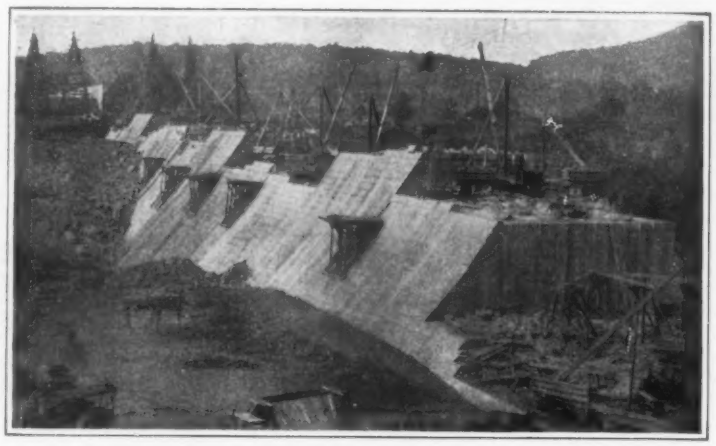
Your correspondent falls into another very great error in assuming that a spring wheel is required to effect the same amount of resilience as the elliptical springs of the car. It is a well-known fact that the resilience offered by a pneumatic tire is but a small percentage of that of the ellipitical springs and thus if the spring wheel reproduces the same shock-absorbing qualities as the pneumatic tires, it answers the purpose perfectly, though it affords but a small percentage of the resilience that the elliptical spring affords.

The writer is thoroughly familiar with the spring-wheel art and he is fully aware that there is no subject in which the automobile trade generally is so misinformed and so needlessly skeptical as to the spring-wheel art, and he therefore wishes to state that every owner of an automobile and everyone interested may take heart, notwithstanding the oft-expressed impossibility of a spring wheel as the spring wheel will supplant the solid wheel with the solid tire and solid wheel with the pneumatic tire beyond the least shadow of a doubt and no one can know the facts of which the writer is possessed without realizing the correctness of this statement.

For the information of those who are in doubt the writer will further state that there is already on the market in a small way a spring wheel which meets the requirements above outlined and which is rapidly gaining headway, and it is only necessary for anyone interested to keep his eyes open as they will be seen in large quantities right in New York city within a very short time.

New York city. M. K. DOMIS.

Olive Bridge dam. Esopus Creek flowing through temporary tunnel.



Building Olive Bridge dam to form the Ashokan reservoir.

Creating a Subterranean River Ninety Miles in Length

How Catskill Water is Being Brought to New York

Phenomenal Growth of New York.

GREATER NEW YORK is adding to its population at the rate of 140,000 people per year—an increase which is absolutely without precedent or parallel in the growth of the world's great cities. Such an increase as this renders enormously difficult the problems of housing, food supply, transportation and proper hygiene. For many years past, and long before the rate of increase had reached its present proportions, the city authorities have been at their wits' end in endeavoring to enlarge the various facilities of the city, so as to keep pace with the demands of its ever-growing population.

The Peril of Water Famine.

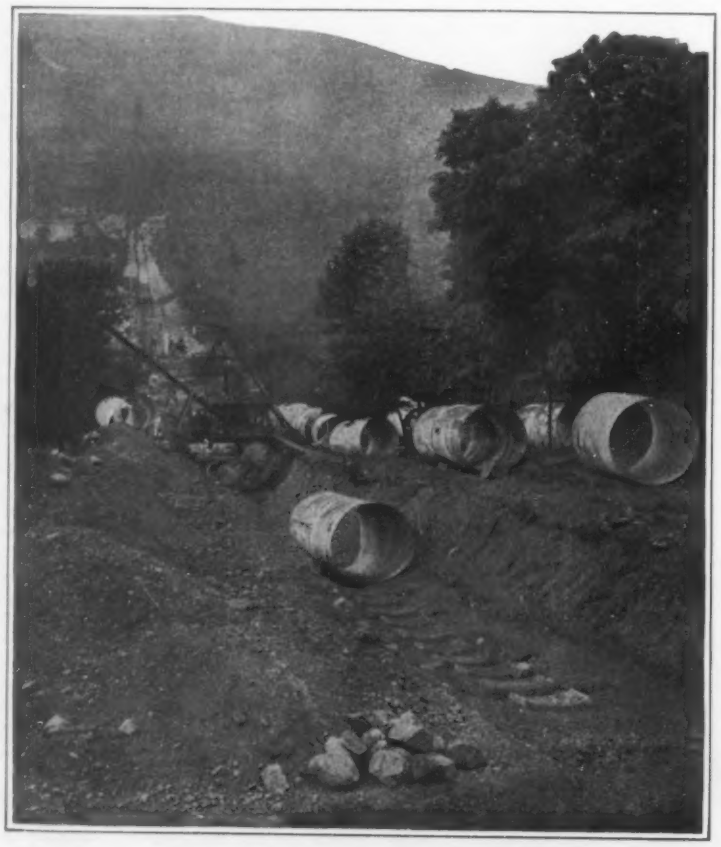
With the exception of rapid transit, there is no problem of the city's need which has proved more serious, more pressing or more difficult, at least in recent years, than that of providing an adequate supply of pure drinking water. At frequent intervals the city has been threatened by that justly dreaded terror, a water famine—justly dreaded, because a shortage, to say nothing of a total failure, of water might mean an outbreak of pestilence, to say nothing of the loss and inconvenience occasioned by the shutting down of the various factories and smaller industries which a shortage of the water supply would necessitate.

It is not so very many months since the whole city was watching, with a very anxious eye, the steady fall of the water levels in the various reservoirs of the Croton watersheds; for a season of drought, extending far into the winter, had served to bring the hitherto remote peril close to its very doors.

In view of the rapid growth of the city, it was evident at the outset that any adequate scheme for increasing the water supply must be made upon the broadest possible scale; and that it should make provision, not only for the immediate needs of the city, but for those of many a decade to come. This has been done by the Board of Water Supply; and it is the purpose of this and the following article to show that the project of bringing the Catskill Mountain water to New York has been considered on such adequately comprehensive lines that the possibility of any shortage of water in this great city has been removed into the very far future.

On May 14th, 1906, the State Water Supply Commission approved of the application of the Board of Water Supply of this city, for obtaining a daily supply of 500,000,000 gallons of water from the Esopus, Rondout, Schoharie and Catskill creeks in the Catskill Mountains, at an estimated cost of $161,867,000. In 1910 a plan for the distribution of the water throughout Manhattan, Queens and the Bronx by a deep pressure tunnel was approved by the Board of Estimate and Apportionment. The additional cost of this scheme is $15,000,000.

In the Hudson River siphon, 1,100 feet below the river.



Placing the nine and one half foot steel pipes—Foundry Brook siphon.

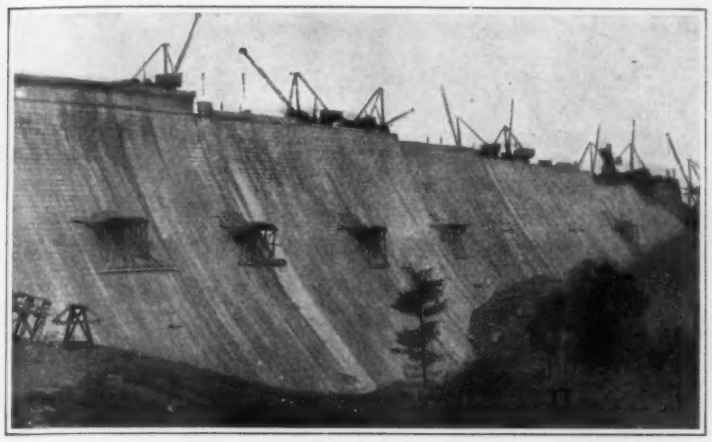
The New Scheme of Water Supply.

The new supply of water, of the finest mountain quality, is to be taken from four watersheds, having a total area of nearly nine hundred square miles. The total estimated capacity of these four gathering grounds is, even in a series of unusually dry years, equal to supplying 770,000,000 gallons daily. Reservoirs will be built, as they are required, in each of these basins, and they will be connected by aqueducts. For the present, the Esopus watershed only is being developed. In a series of dry years this watershed can furnish a daily supply of only 250,000,000 gallons; but the aqueduct leading to the city is being built of double that capacity or 500,000,000 gallons daily. The first contract for construction was let at the close of 1906. In 1907 to 1908 about five per cent of the work was completed from Ashokan reservoir in the Esopus watershed to Croton Lake. By the end of 1909, 22 per cent was done, 60 per cent at the close of 1910, 78 per cent by 1911, and at the present time about 95 per cent of the work is done. The delivery of water into the Croton reservoir, which will be possible this year, will prevent any possibility of water famine during the completion of the new aqueduct to New York.

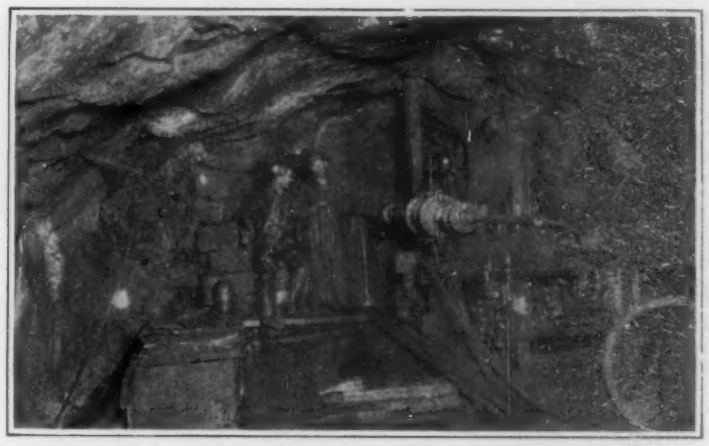
The system under construction and now nearing completion consists of a large reservoir in the Esopus basin, an underground aqueduct seventeen feet in diameter by which the water is led for sixty-four miles to another large basin, the Kensico reservoir, which will serve for emergency storage; a third reservoir situated about fifteen miles south of Kensico and just over the New York city line, known as the Hill View reservoir, which will equalize the difference between the use of water in the city, which, of course, varies from hour to hour and from day to day, and the steady flow coming in from the aqueduct. Between Hill View and the city the system consists of a deep circular, high-pressure tunnel, through which the water will be led beneath Manhattan, to be distributed by surface mains throughout that city, and also throughout the other districts of Greater New York.

The Ashokan Reservoir.

The great Ashokan reservoir is situated about fourteen miles west of Kingston on the Hudson River. Its cost is $18,000,000, and it will hold sufficient water to cover the whole of Manhattan Island to a depth of twenty-eight feet. The water is impounded by the Olive Bridge dam, which is built across Esopus Creek, and also by the Beaver Kill and the Hurley dikes, which have been built across streams and gaps lying between the hills which surround the reser-



The Olive Bridge dam, 4,650 feet long, 220 feet high.



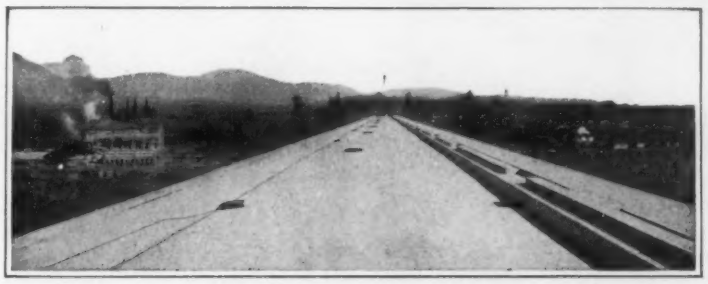
Diamond drill boring horizontal hole 1,100 feet below Hudson River.

voir. By the first of January, this year, 73 per cent of this work was done. The dam is a masonry structure 190 feet in thickness at the base, and 23 feet thick at the top. The surface of the water when the reservoir is full is 590 feet above tide level. The total length of the main dam is 4,650 feet, and the maximum depth of the water is 190 feet. The area of the water surface is 12.8 square miles, and in preparing the bottom it was necessary to remove seven villages, with a total population of 2,000. Forty miles of highway and ten bridges had to be built. In the construction of the dam and dikes it was necessary to excavate nearly 3,000,000 cubic yards of material, and 8,000,000 cubic yards of embankment and nearly 1,000,000 cubic yards of masonry had to be put in place. The maximum number of men employed on the job was 3,000.

The Ninety-two Mile Aqueduct.

The water is conducted from Ashokan reservoir as a huge, underground, artificial river. The aqueduct is ninety-two miles in length from Ashokan to the northern city line, and it should be explained that it is built on a gentle grade, and that the water flows through this at a slow and fairly constant speed. The aqueduct contains four distinct types: the cut-and-cover, the grade tunnel, the pressure tunnel, and the steel-pipe siphon. The cut-and-cover type, which is used on fifty-five miles of the aqueduct, is of a horseshoe shape and measures seventeen feet high by seventeen feet six inches wide, inside measurements. It is built of concrete, and on completion it is covered in with an earth embankment. This type is used wherever the nature of the ground and the elevation allow. Where the aqueduct intersects hills or mountains, it is driven through them in tunnel at the standard grade. There are twenty-four of these tunnels, aggregating fourteen miles in length. They are horseshoe in shape, seventeen feet high by thirteen feet four inches wide, and they are lined with concrete. When the line of the aqueduct encountered deep and broad valleys, they were crossed by two methods: if suitable rock were present, circular tunnels were driven deep within this rock and lined with concrete. There are seven of these pressure tunnels of a total length of seventeen miles. Their internal diameter is fourteen feet, and at each end of each tunnel a vertical shaft connects the tunnel with the grade tunnel above. If the bottom of the valley did not offer suitable rock for a rock tunnel, or if there were other prohibitive reasons, steel siphons were used. These are nine feet and eleven feet in diameter. They are lined with two inches of cement mortar and are imbedded in concrete and covered with an earth embankment. There are fourteen of these pipe siphons in a total length of six miles. At present one pipe suffices to carry the water. Ultimately three will be required for each siphon.

Of the many siphons constructed, by far the most interesting and difficult is that which has been completed beneath the Hudson River. The preliminary borings made from scows in the river showed that great depths would have to be reached before rock sufficiently solid and free from seams was encountered to withstand the enormous hydraulic pressure of the water in the tunnel. After failing to reach rock by the scow drills, two series of inclined borings were made from each shore, one pair intercepting at about nine hundred feet depth and the other at about fifteen hundred feet. Both showed satisfactory rock; and accordingly a shaft was sunk on each shore, to a depth of approximately eleven hundred feet, and then a horizontal tunnel was driven connecting the two. It is of interest to note that because of the enormous head, which must be measured from the flow line far above the river surface, the pressure in the horizontal tunnel reaches over forty tons per square foot.



This will form part of a system of new highways.

Driveway along crest of Olive Bridge dam.

Through this chamber the flow of water to the aqueduct will be regulated.

Ashokan reservoir—Upper gate chamber.

Constructing a steel and concrete section of aqueduct.

This section consists of a steel pipe, lined internally with two inches of cement mortar, and embedded in reinforced concrete.

Kensico Reservoir.

Next to Ashokan the most important basin is the Kensico reservoir, which lies east of the Hudson, and is situated thirty miles north of the City Hall. It will hold sufficient of the Catskill water to supply the city for several months. Its purpose is to act as an emergency storage reservoir, so that if it is necessary, on account of accident, to interrupt the flow in the seventy-seven miles of aqueduct between Kensico and Ashokan, this can be done without interrupting the city supply. The cost of this work is $8,500,000.

The reservoir will be formed by a huge masonry dam across the valley of the Bronx River. The surface of the water will be at an elevation of three hundred and fifty-five feet above mean sea level, and will cover 2,218 acres. It will contain, when full, about 40,000,000,000 gallons, of which 29,000,000,000 gallons, or sixty days' continuous supply at 500,000,000 gallons daily, will be available. The main dam will be eighteen hundred and forty-three feet long; the total height will be three hundred feet; it will be two hundred and thirty feet thick at the base, and twenty-eight feet thick at the top. The average depth of the reservoir will be one hundred feet, and its maximum depth at the wall of the dam will be one hundred and fifty-five feet. An interesting feature of the construction is that the entire dam will be divided into sections by transverse expansion joints, which will be placed about eighty feet apart longitudinally. On one side they will be faced with concrete blocks, forming a series of vertical tongues and grooves, against which the masonry of the other side will be built. Near the up-stream face will be a copper strip, which will cover the expansion joints and act as a water stop, the strips continuing from the bottom to the top of the dam. In order to catch any water that may seep through from the up-stream side, diagonal wells will be built fifteen feet apart, measured longitudinally. They will be formed of porous concrete blocks. They will reach from the top of the dam to a longitudinal inspection gallery at about the level of the reservoir bottom, which will in its turn be connected with a transverse drainage gallery,

which will lead to the downstream base of the dam. This will prevent any seepage entirely through the wall, and will avoid that discoloration which is liable to mar the architectural beauty of structures of this kind.

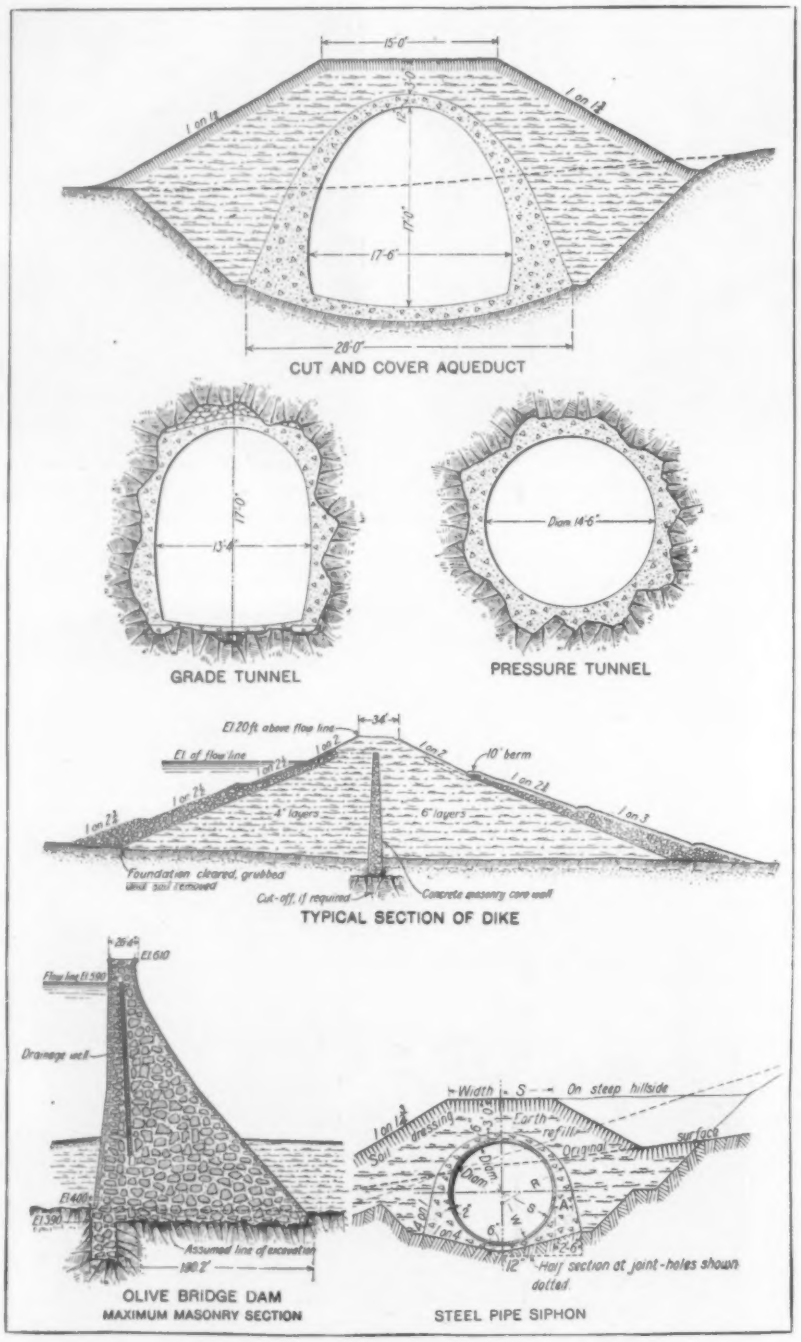
Aeration and Filtration.

Both at the Ashokan and Kensico reservoirs aerators will be built, each of which will be capable of passing and treating all the water which will flow in the aqueduct. The aerator is a large rectangular basin, five hundred feet by two hundred and fifty feet; containing about eighteen hundred nozzles, through which jets of water will be thrown into the air. The nozzles will be of such form that the water will be divided into a fine spray, and this will permit of a thorough admixture of the oxygen of the air and the removal of gases and matters which would cause taste and odors. For the present no provision will be made for filtrating the Catskill water, but provision has been made for a filtration plant by the purchase of three hundred and fifteen acres of land near Tarrytown, adjacent to the aqueduct.

Hill View Reservoir.

From Kensico the water will flow to the Hill View reservoir which will serve to equalize the difference between the amount of water used in the city and the amount of water flowing in the aqueduct. Also it will furnish a great quantity of water should there be an immediate demand, such as occurs during a great conflagration. Its capacity will be 900,000,000 gallons. The reservoir is divided into two basins, so that one may be used while the other is being inspected for repairs. The aqueduct is carried within the wall which divides the two basins, and the aqueduct water can be passed through the reservoir, and delivered directly into the city tunnel.

Our thanks are due to Mr. Alfred D. Flinn, Department Engineer of the Board of Water Supply, for courtesies extended during the preparation of this article.



Sections of the aqueduct and dams—Catskill water supply.

The International Building Exposition in Leipzig

An International Building Exposition will be held in Leipzig this year. The time during which applications for space may be submitted has recently been extended until the end of February, in order to permit firms which have not yet submitted applications to make good this omission. Space to the value of more than a quarter of a million dollars has already been allotted, and the demand is still brisk.

Dr. Probst of Berlin, whom the directors sent to this country to arouse American interest in the exposition and to secure adequate participation therein by the United States Government, cities, associations, industrial firms, etc., has described his travels in a lecture, delivered in Leipzig, of which the following is an abstract:

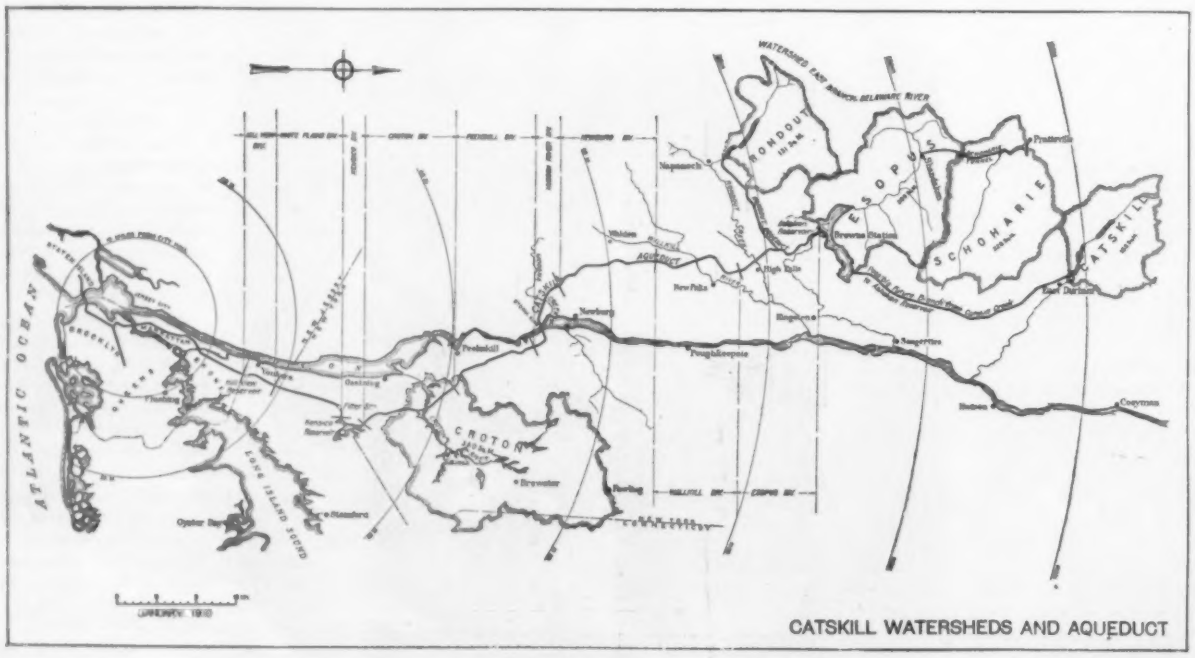
The United States Government shows much interest in the exposition. The cities of New York, Chicago, Philadelphia, and San Francisco, the American Bridge Company (the oldest and greatest of American bridge-building firms), and the Canadian Railway Company will exhibit typical models and photographs of "skyscrapers," bridges, city views, schools, waterworks, etc. Very complex problems are presented to American engineers by peculiar geological, climatic and traffic conditions. The exhibition will show how these problems are solved in the eastern, central, and western States.

Both the rapidity and the methods and materials of American building are greatly influenced by the exceedingly high rate of wages ($5 or $6 per day) and by the almost total absence of legal building restrictions. The high cost of labor has led to the substitution of machine work for hand work as far as possible. The lack or deficiency of building laws in many places has permitted speculative builders to erect unsafe structures. A striking instance of this was revealed after the earthquake in San Francisco, where foundations of many of the fallen buildings were found to have been constructed in the most reckless manner. Praiseworthy energy was then displayed in the erection of a new city, which may be regarded as structurally unexceptionable. Examples of the new buildings of this beautiful city will be represented at the Leipzig exposition.

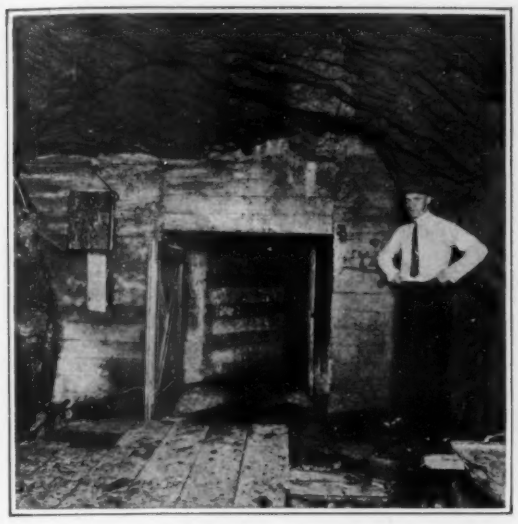
Almost everywhere in America, Dr. Probst noted, with approval, a sharp demarcation between business sections and residence sections, which does not exist in Europe, outside of England, but he was unfavorably impressed by the lawless co-mingling of ordinary four-story and five-story buildings with towering structures of thirty or more stories. American engineering societies, however, are beginning to give attention to aesthetic and hygienic considerations which have hitherto been ignored, and many of their members will visit the Leipzig exposition, where these matters will be fully illustrated.

Dr. Probst finds ferro-concrete the building material most extensively used in America, and mentions an ingenious device employed in the construction of most large buildings and consisting of a central tower from which the concrete flows through a movable spout to any spot where it is wanted.

The projected Chicago ship canal will be well represented at Leipzig. Dr. Probst regards Canada, with its great fertility and scenic beauty, as the land of the future and the most promising field of activity for the building engineer. In conclusion, Dr. Probst named as the two most eminent American building engineers, Lindenthal and Hornborstel, both of whom will exhibit models of their works at the coming Leipzig Building Exposition

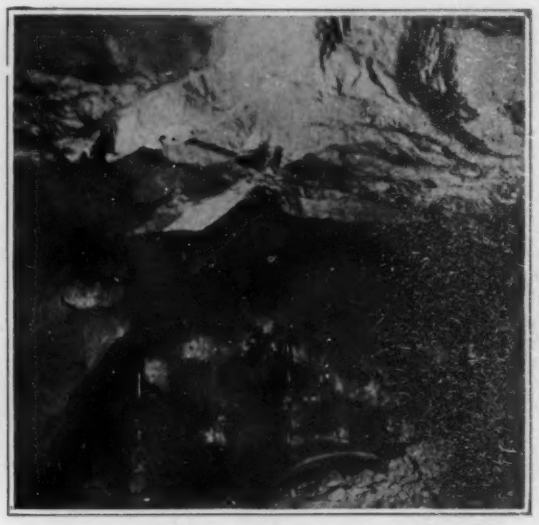


Map showing Catskill and Croton watersheds and the aqueduct.



Magazine door, which closes automatically in case of explosion.

Dynamite chamber. Note the roof over the shelves.



Drill posts set up at a tunnel heading, two drills on each post.

Supplying a Metropolis With Mountain Water

How Mining Operations Are Being Carried on Through the Heart of New York

THE preceding pages tell how the new aqueduct is being constructed from the Catskill Mountains down to the New York city line, where, at the Hill View reservoir, the waters will pause before taking their plunge into the heart of the city.

The problem of admitting so large a flood into the metropolis is no small one, particularly when the chief demand for the water will come from those sections of Greater New York which lie many miles away. For the present, at least, little if any of the Catskill water will be used in Manhattan and the Bronx, but most of it will be consumed by the boroughs of Brooklyn, Queens, and Richmond. The Water Waste Campaign which has been carried on for the past few years has so far reduced the consumption of water that the Croton system, which can furnish steadily 350,000,000 gallons of water per day, can easily take care of the immediate wants of Manhattan and the Bronx as well as the demand from these two boroughs for many years to come. It is not likely that the population in Manhattan will increase much unless it undergoes a marked, vertical growth, for now there are practically no more vacant lots to be built upon. So that in estimating the future demands upon the Croton system we must consider chiefly the growth of population in the Bronx. In the other three boroughs of the city, however, there is a present demand for water and the probability of large increases in population in coming years.

To conduct the Catskill water into Brooklyn and Queens, it was decided to build a trunk line, so far beneath the surface that there would always be 150 feet of good solid rock for the roof of the tunnel, and provide a course for a subterranean river which could be tapped as needed for the city's supply, and which, at the same time, would be so completely buried that it would never menace the safety of structures above it. When this tunnel is completed it will be one of the most durable pieces of work ever constructed by man; for practically nothing but an earthquake can destroy it; and even this possibility is very remote, for the rock underlying New York is of very early formation and not at all liable to seismic disturbance. And so the city tunnel of the Catskill aqueduct is being bored through the rock on the average of 200 to 250 feet below the surface except in places where the nature of the rock is of such a character as to call for a much greater depth.

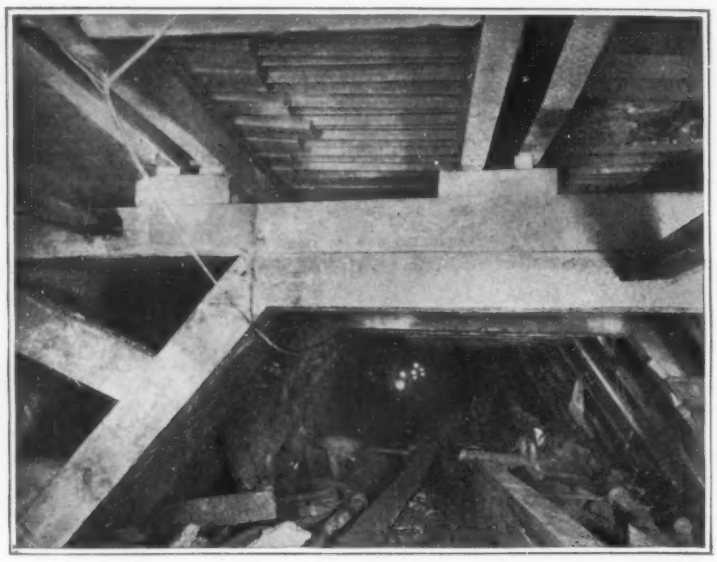
The first dip takes place just above the Harlem River, where the tunnel drops down 362 feet below the ground level. Then it runs practically horizontally until it passes the dip in the rock under 125th Street. Thence it rises again and maintains a practically constant level of 200 feet under the city, until it arrives at the ancient bed of the East River. A glance at the map of New York city will show that the East River makes a decided turn about the lower east side or "heel" of Manhattan. In pre-glacial times, the East River had no elbow in its course, but ran directly across the heel of Manhattan, and it wore away the rock in its bed to considerable depths. However, the large deposits of earth and rock carried by the glaciers caused the river to be pushed eastward out of its normal channel and over the solid rock beyond. When borings were made for the aqueduct through this section of the city, it was found necessary to lay it at a depth of about 750 feet below the surface. As indicated in the accompanying drawing, much of the rock through this section is decayed and unfit to form the walls of a high-pressure aqueduct which is being built to last for all time. The present channel of the East River, on the other hand, passes over solid rock, and is comparatively very shallow. Seven hundred and fifty feet is an enormous depth, second only to the great siphon under the Hudson River, which is 1,114 feet below the river surface. It so happens that the deepest shaft ever sunk in New York city equals the height of the tallest building in the world. To illustrate this enormous depth, our artist has taken the liberty of building the Woolworth Building topsy-turvy, that is, from the ground down, at the Clinton Street shaft at the west bank of the East River. Enormous as is the building, yet it barely reaches the aqueduct at this point. Evidently there will be plenty of cellar room over the tunnel, and yet it is worth noting, the aqueduct follows the street lines so as not to trespass on private property!

The height of the Woolworth Building equals the depth of the deepest aqueduct shaft in New York.

Arrived in Brooklyn, the aqueduct rises again to within two or three hundred feet of the surface, and is pushed as far as it is possible to carry it in solid rock and yet communicate with the surface. This limit was found to be at the junction of Flatbush and Third avenues. Here it was necessary to go through 215 feet of overlying earth before coming to the rock. The caisson method had to be resorted to, and the caisson was sunk over 100 feet below the water line before rock was reached. Considerable difficulty was here experienced in sinking the shaft to the rock, because it called for the use of pneumatic pressure that taxed the endurance of the workmen to the limit. From here on the water will be conducted through pipes laid in a trench of a moderate depth below the surface. From the foot of Seventy-ninth Street, Bay Ridge, the conduit will be run across the Narrows to Staten Island, through a pipe 36 inches in diameter, provided with flexible joints, and laid in a submarine trench. The details of this section of the work have not yet been given out. However, tests have been made to discover at what depth the pipe line under the water must be buried. It is evident that it must lie far enough below ground to prevent its being entangled with anchors from large vessels that may have to anchor in the Narrows. The matter has been thoroughly investigated, and practical tests have been made by dragging anchors of large size along the bottom. It has been determined that if the pipe line is buried at least eight feet under the bed, it will be entirely safe. On the Staten Island side a 48-inch pipe will carry the water on up the hill and through a tunnel into Silver Lake reservoir, 120 miles from the source in the Catskills.

The greatest interest in this city section of the aqueduct attaches naturally to that part which is being excavated through solid rock under the busy city. It is a surprising fact that a work of such magnitude can

"Holed through" from shaft 16 to shaft 17. Dangerous rock overhead due to vertical seams.



Permanent channel iron support for a treacherous roof. The beams will be imbedded in the concrete lining.

be carried on directly under our feet without inconveniencing us in the least. The only surface evidence of the deep rock tunneling is to be found at the various shafts which are located in parks, or public squares. The principal difficulty that presented itself at first was the question of storing explosives for a work of such great proportions. To keep the necessary explosives on the surface was to harbor constant menaces to the lives of the citizens. The matter was finally solved by placing the dynamite magazines far under the surface in the rock, and setting the doors to these magazines so they will automatically close in case of an explosion and trap the hot and poisonous fumes in the rock chamber, where they can do no harm to the workmen. The idea was borrowed from European practice, where mining operations are conducted close to and sometimes directly under large cities. Access to the dynamite chamber is had through a zigzag drift. At each turn of the drift a pocket is excavated, and the chamber itself is made of large capacity. In this chamber the dynamite is stored under a protecting roof to keep off any fragments of rocks that might fall when jarred by the "shooting" in the tunnel. At the entrance of the drift a very substantial concrete bulkhead is built, and in this is a low doorway. The door is of massive construction, built of I-beams, sixteen inches deep and spaced apart with oak beams twelve inches square. The door has beveled edges, so that it will seat itself snugly in the doorway. The door is always kept open at an angle of about 45 degrees. In the magazine a thousand pounds of dynamite may be kept at a time. Should this be exploded, the explosion wave would have to travel down the zigzag passage and would lose much of its force at each abrupt turn, finally striking the door with greatly diminished energy. The door would be slammed shut by the blast of air issuing from the drift, and would then be held shut by the gases of the exploded dynamite. A magazine of this sort has been constructed near the foot of each shaft—not *at* the foot, however, for fear that in case of a mishap, it might block the escape of the men. The magazines have been tested by exploding a number of sticks of dynamite around the first bend in the drift, and in every case the door has closed just as expected.

The work through the rock is being pushed very rapidly; at some of the shafts between 800 and 1,000 pounds of dynamite have been used daily. Within the last year millions of pounds of dynamite have been exploded under the city, while most of New York was totally oblivious to the fact. Already a number of the tunnel sections have been "holed" through. To expedite the work, one contractor is using an interesting form of shoveling machine, built especially for this work, so that it may be taken down the comparatively narrow shaft and be assembled to work within the small diameter of eleven feet, which is the size of the tunnel at the particular point where this machine is now being used. A photograph of this machine is shown herewith, and also a drawing illustrating the mechanism. The machine is controlled by a single operator, and does the work of six laborers. It is provided with a double shovel *A* and *B*. The section *A* digs up the rock and throws it upon the scoop *B*, which in turn empties its load upon a traveling chain conveyor *C*; the latter delivers the load into muck cars at the back of the shoveling machine. The letters *B*, B^1, B^2, and B^3 show the successive positions of the scoop. The forward section *A* is carried upon a crank-shaft *D*, which is revolved through the arc indicated by the arrow. Another arrow line shows the course of the front edge of the section *A*. The forward end of the scoop *B* rests upon the heel of the section *A*, while its rear end is mounted upon a shaft *E*, which travels in a guideway *F*. The forward section *A* is connected to the shaft *E* by means of side plates, indicated by dotted lines, so that as the crank-shaft *D* revolves, the slide shaft *E* is obliged to run up the ways *F*, as indicated by the letters E^1, E^2, and E^3. The section *B* is equipped with a small arm *G*, which carries a roller that is adapted to engage the cam groove *H*, causing the scoop *B* to turn over as indicated in the dotted view B^3, and empty its load upon the traveling conveyor. The machine is mounted on a turntable, so that it may be turned about in any direction.

Some of the work on the city pressure tunnel has been hurried so far that certain sections are now being lined with concrete. The forms used for this purpose are very interesting. Our front page illustration shows their construction. They cover 120 feet altogether and are arranged in two sections, sixty feet of the lower half of the tunnel being concreted in an advance of sixty feet of the upper part. The first step is to lay the "invert," that is, a narrow segment of the lining running along the bottom of the tunnel. This,

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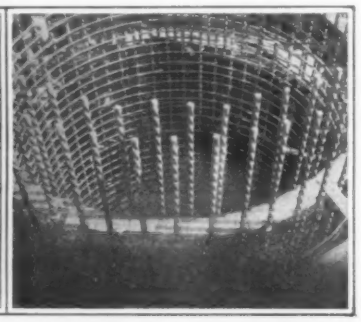
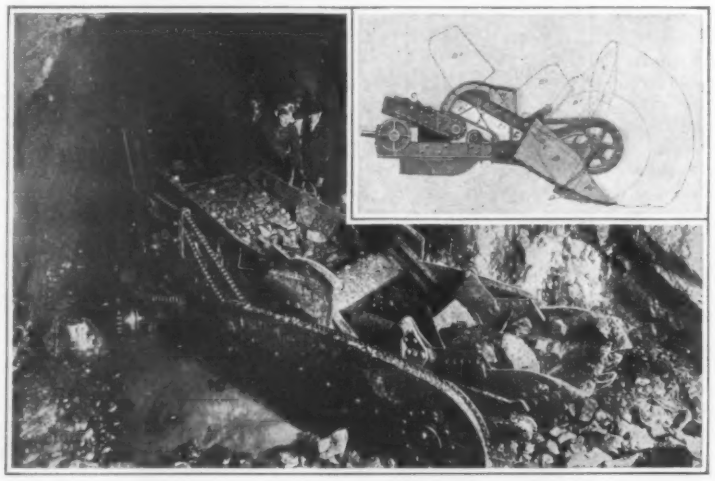
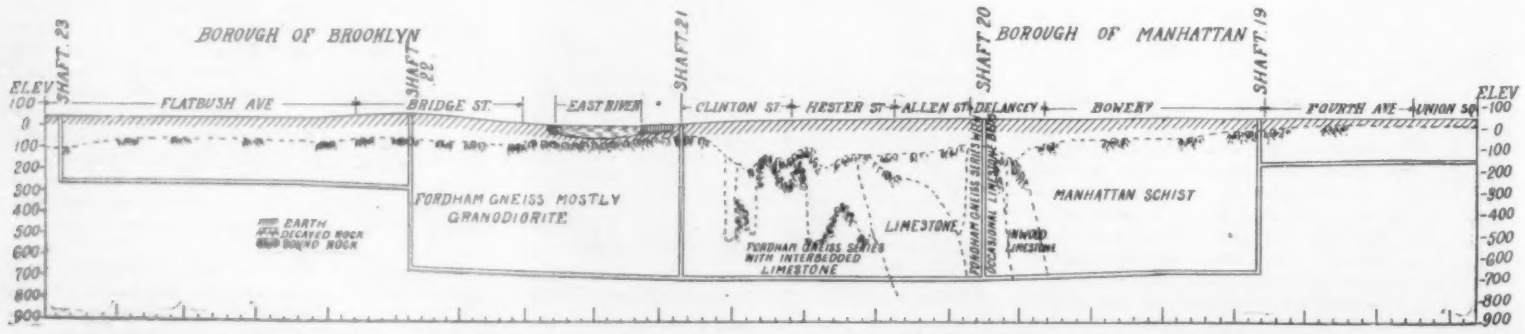
Looking down the 441-foot shaft at 149th Street.



Reinforcement for the caisson at Flatbush and Third avenues.



Shoveling machine for removing the broken rock and loading it into cars.



Section along the city pressure tunnel, showing how it has to dip down under the pre-glacial bed of the East River.

The Heavens in March

Eclipse of a Star by One of Jupiter's Moons

By Henry Norris Russell, Ph. D.

A VERY unusual piece of astronomical work, from a part of the world in which little has previously been done, deserves description this month. Though published in the German *Astronomische Nachrichten*, it originates in Chile, where Dr. Ristenpart, a German astronomer of distinction, is in charge of the observatory at Santiago.

On the night of August 13th, 1911, the third satellite of Jupiter, Ganymede, passed directly in front of a star of the seventh magnitude, in the constellation Virgo, and for observers in the southern part of the Earth, actually hid the star for more than four minutes.

The circumstances of this remarkable occultation were carefully calculated in advance by Banaclaiewicz, and it appeared that the best observing stations would be in South America. Dr. Ristenpart, with great energy, set about the organization of observers throughout Chile, and it is undoubtedly due to his zeal and forethought that the important results which we are to describe were obtained.

Why it was important to have observations made at as many places as possible appears from the fact that, since Ganymede is much smaller than the Earth, its shadow, if we may so describe the region from which at any moment it conceals the star, is only a little more than 4,000 miles in diameter.

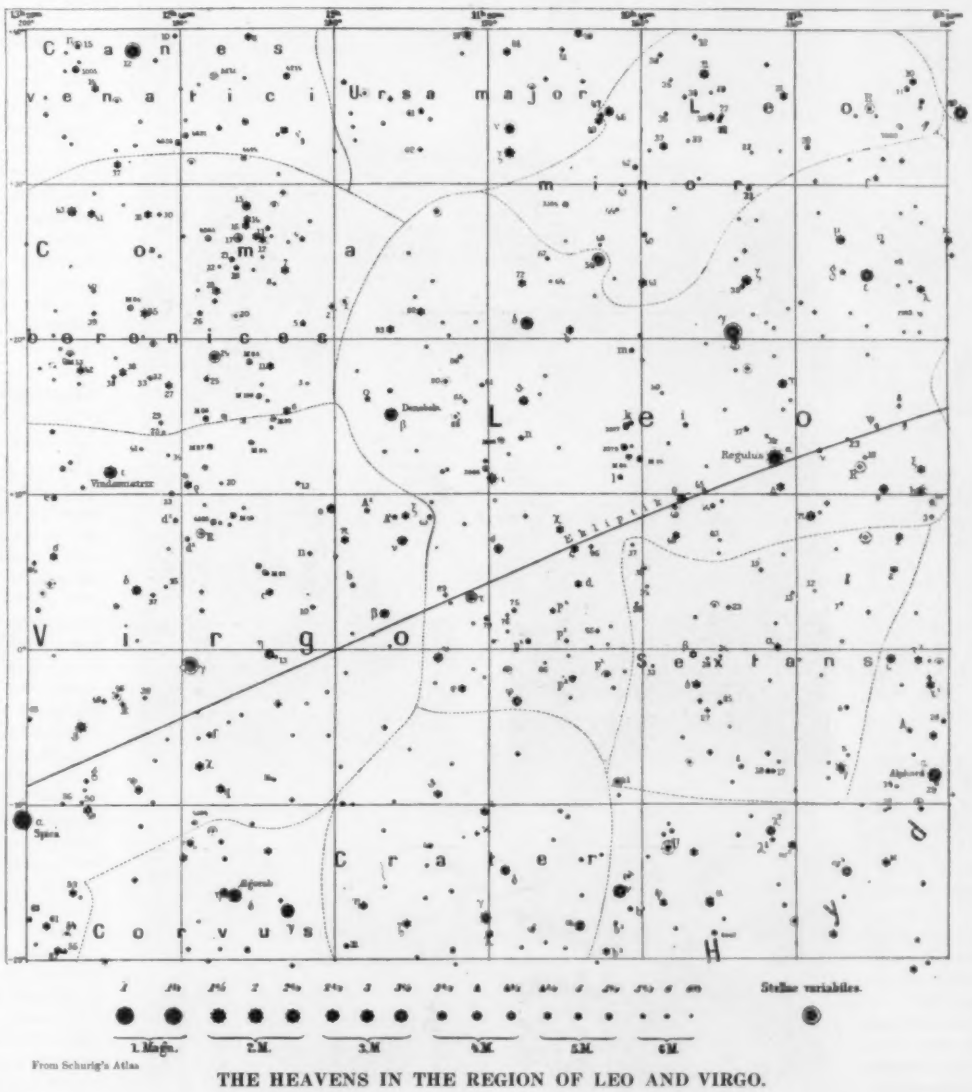
As Jupiter and its satellite moved, this "shadow" crossed the Earth, its center passing over the southern extremity of South America, a little north of the Straits of Magellan, while its northern limit reached barely to the boundary between Chile and Peru. Observers at southern stations would therefore see the satellite pass almost centrally over the star, while for those in northern Chile, the latter would be concealed for a much shorter time behind the northern edge of Ganymede.

By comparison of the duration of the occultation, as seen from different places, it should therefore be possible to obtain very accurate information regarding the size and shape of the eclipsing body. In spite of unfavorable weather and other difficulties, the various observers—mostly school teachers or amateur astronomers—were able to obtain reliable observations at five stations, extending almost along the same meridian for 1,000 miles. Except at Santiago, the observers had only small telescopes of about four-inch aperture, with which the satellite could not be distinguished, as regards its appearance, from the star, except that it was a little brighter. The two came closer together until they could no longer be distinguished, but formed one mass of light. Then, suddenly, the light diminished to about one half, this being, of course, the real instant when the star vanished behind the satellite. After a time the light increased again as the star came out; and then the mass of light gradually separated into two points.

In addition to these visual observations, a number of photographs were obtained by Dr. Zurbellen, which defined very accurately the relative positions of the star and satellite before and after their conjunction, and made it possible to calculate just how far apart they must have appeared at any time.

Working along these lines, Dr. Ristenpart finds that, in order to get a satisfactory agreement between theory and observation it is necessary to assume that the satellite, like Jupiter itself, is flattened at the poles, for otherwise the calculated length of the occultation at the northernmost station, where the star appeared to pass just inside the satellite's disk, would be much longer than the observed time. As the rate of motion of the satellite is accurately known, the maximum length of the occultation affords a very precise measure of its diameter. Dr. Ristenpart finally concludes that the equatorial diameter of the satellite is 4,700 miles, and the polar diameter 4,300, so that it is a little more flattened, in proportion to its size, than Jupiter himself. The diameter of the satellite was previously supposed, from micrometer measures, to be about 3,600 miles, and the difference between this and the new value is surprisingly large; but owing to the method of observation, Dr. Ristenpart's results seem to be entitled to very serious consideration. The mass of this satellite is known, from its attraction on the other satellites, to be about 1/12,000 that of Jupiter, or a little more than 1/4 that of Mars. But, according to the results just given, it is a little larger than Mars. This would make its density less than ¼ that of Mars, and actually less than that of water—intermediate between the densities of Jupiter and Saturn. Even with this low density, it must be in rapid rotation, with a period not more than ten or twelve hours, to account for the polar flattening.

It is perhaps most interesting of all to note that, according to the most definite of the observations, the disappearance of the star behind the satellite was almost instantaneous, the loss of light lasting only a second or so. This means that the apparent diameter of the star was not more than 1/300 that of the satellite; in other words, less than 1/500 of a second of arc. This is quite what is to be expected for a star of the seventh magnitude; but it is interesting to have the extreme smallness of the apparent diameter of a star confirmed by direct observation.



From Schurig's Atlas

THE HEAVENS IN THE REGION OF LEO AND VIRGO.

The Heavens.

We give again this month a detail map showing a portion of the sky which is now favorably placed for evening observation. Any one familiar with the constellations can easily pick out upon it the "Sickle" of Leo toward the west—that is, on the right, for on maps of the sky, toward which we look *upward*, the position of east and west, if the north is at the top, is necessarily different from what they would be on maps of the Earth's surface, at which we always look downward.

Among objects of telescopic interest here are Gamma Leonis, in the "Sickle," a very well known binary pair, now separated by 3.5 seconds, and in very slow motion, so that a complete revolution can hardly take less than 1,000 years. The bright star Regulus, at the end of the handle of the "Sickle," has a companion of the eighth magnitude, a little less than 3 minutes away, which, in spite of its great distance from its primary, shares the proper motion of the latter, and is doubtless really as near it as it appears to be. Fifty-four Leonis, in the northern part of the constellation, is a pretty pair with components of the fourth and sixth magnitudes, 6 minutes apart.

South and east, in Virgo, the star γ is a famous binary, which has been followed for the greater part of its period of one hundred and ninety years. At present the two stars are at their widest separation, about 6 seconds apart, and can be separated with a very small telescope, as can the pairs previously mentioned. In 1836, however, they were less than one tenth as far apart as now, and could only be divided by the most powerful instruments of that day.

ξ Ursæ Majoris, which may be found near the northern edge of the map, just north of 3 Leonis, is another very fine binary pair, with a period of sixty years. The components are now at their greatest separation—nearly 3 seconds—and can be resolved by instruments of very moderate power.

The Planets.

Mercury is evening star until the 27th, when he passes through inferior conjunction, and becomes a morning star. He may best be seen about the 10th, when he sets about 7:30 P. M. Though only 18 degrees from the Sun, he is north of him, and very bright (excelling Vega or Arcturus), and, being in Pisces, in a region very poor in bright stars, can easily be identified.

Venus is evening star, too, at her greatest brilliancy, appearing about twelve times as bright as Sirius, and more than 100 times as bright as Aldebaran. She casts a conspicuous shadow, if her light is allowed to shine through a window into a darkened room, and can be easily seen in the daytime if one knows just where to look. Shortly before sunset, any one can pick her up, high in the western sky, while the Sun is still shining.

At the beginning of March she sets about 9:30 P. M., and remains in sight until nearly 9 o'clock at the end of the month.

Mars is a morning star in Capricornus, rising about 5 A. M. Jupiter is likewise a morning star, but is farther east, in Sagittarius, and rises about 2:15 A. M. in the middle of the month. Saturn is evening star in

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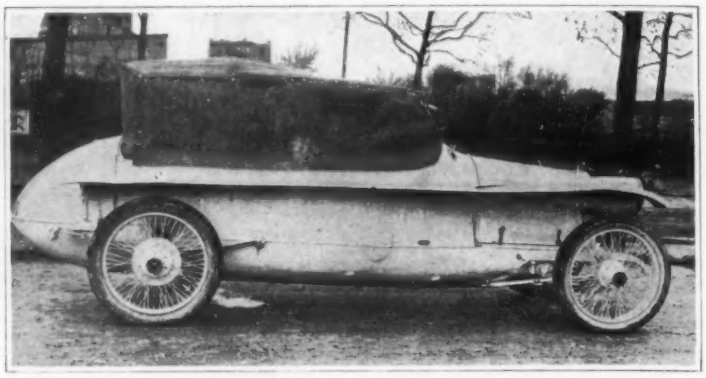
The Turcat-Mérz torpedo, with hood removed.



The Turcat-Mérz torpedo, with canvas hood.

Queer Automobile Bodies

Some Interesting French Designs

THE development of automobiling has been attended by a corresponding development in the construction of automobile bodies, even by an overdevelopment, which has produced queer forms that depart widely from the conventional types, although they are not always unpractical or destitute of merit.

Most of these queer looking automobiles are of French make. A well known example is the Grégoire "submarine," which conceals all but the head of the driver. The same firm makes a still more realistic "submarine," which is provided with a conning tower, and completely incloses the driver. Then there are cars shaped like artillery shells, with rounded tail pieces in which extra wheels or tires are neatly stowed, and other shell types with glass skylights.

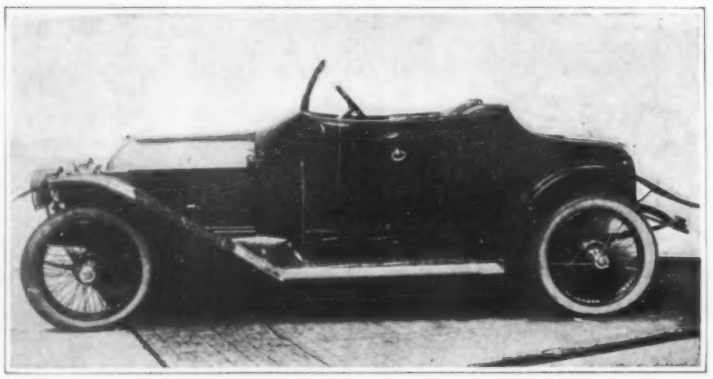
Three novel and bizarre automobile bodies of French make are described and illustrated in the present article, taken from the *Allgemeine Automobil Zeitung*. The first is a Turcat-Mérz body, which is called "The Shark," because it strikingly resembles that fish, especially when seen from in front, owing to the peculiar combination of the lanterns with the mudguards. This constructive device was first suggested in a Napier car, which was shown at the last Olympia exhibition in London, and in which the front lanterns were mounted on the ends of the guards. The next development was the mounting of the top lantern on one of the rear mud-guards. Finally an ingenious constructor conceived the idea of incorporating the lanterns with, instead of mounting them on the guards. This construction is certainly queer, but it is eminently practical, if it is solidly and substantially executed, because the lanterns sharply mark the two extreme front points of the car.

The other two cars herewith illustrated represent two solutions of the problem, which many constructors have attacked, with more or less success, of producing an open car which can be converted into a closed one without showing at all times the mechanism and the additional parts by which the transformation is effected.

One of these vehicles, the "torpedo" made by Turcat-Mérz, is provided with a canvas cover, which can be entirely concealed in the body of the open car, so that the graceful lines of the torpedo are not marred. This cover affords complete protection and is provided with glass windows.

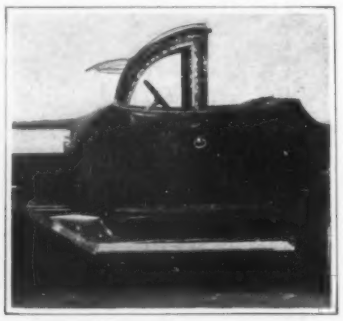
Still more ingenious is the "Phenix," officially designated "*Torpedo conduite intérieure Phénix à décapotage complet*," i. e., a torpedo-shaped Phenix car, controlled from the inside of a hood which can be made to disappear completely. Two-seated closed cars, controlled from the inside, are now very popular, and in many styles, some of which are very luxurious and costly. The new Phenix car appears to furnish every possible gradation between the completely closed and the entirely open vehicle. It also presents a very graceful appearance, and its lines show originality. The hood is composed of two quarter cylinders, which turn in pivots and can be raised and lowered separately.

The sides of the hood are glazed, and there is a hinged glass window in its convex front. Behind the hood is a disappearing seat for a servant. The front part alone gives sufficient protection against an unpleasant head wind in otherwise agreeable weather. When the front part is dropped a small portion of it remains to form a wind shield of the usual type.

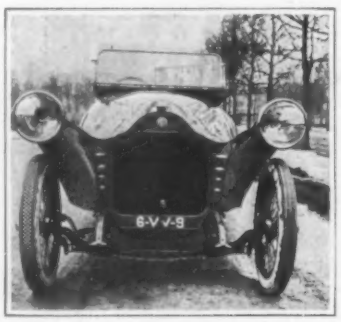


New Phenix car, entirely open.

Hood of new Phenix car, closed.

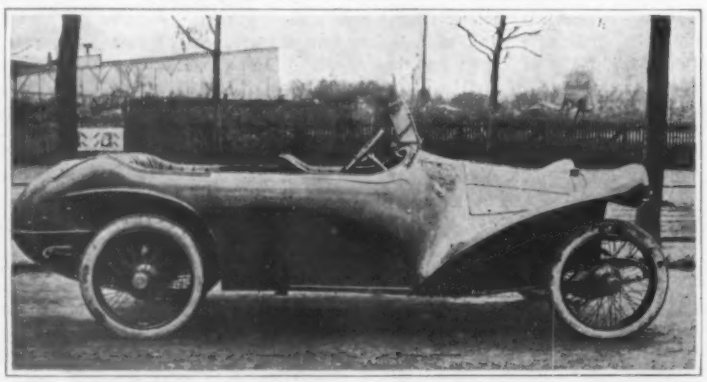


Hood of new Phenix car, half closed.



Front view of "The Shark."

After part of "The Shark."



"The Shark," so named because the peculiar combination of the lanterns with the mud-guards suggests a monster of the deep.

Treating Table Refuse for Animal Food

A SOMEWHAT original method of securing food for animals from otherwise wasted substances is now being applied in Germany, and it appears to be worthy of note on account of the economy which could thus be secured. At Charlottenburg the city regulations require that all remains of food be placed apart from other household waste, such remains being collected separately each day and taken to a special plant, where they are treated so as to obtain a food product. They are first freed from all non-nutritious matter, which is always present, then the material is ground, pressed and dried and finally transformed into a kind of meal which is sold under the name of "bread meal." This is used in the original state or mixed with molasses. It is fairly nutritive, but has a large percentage of ash, this being due to the large quantity of bones contained in the waste material. M. Hansen made experiments with the meal in feeding milch cows, and his tests bore upon 76 head divided into three lots, lasting for over three months. The results were encouraging, and he considers that the meal should be used alone without mixing with other substances. He brings out the advantages which would be obtained in the way of economy and figures that should such a method be applied in German cities of over 200,000 inhabitants each, totaling 9,000,000 population, the yearly product would be valued at $2,500,000 for stock raising purposes.

Sharpening a Pencil

AN expert manual training man talked with the writer about so simple a thing as sharpening a lead pencil. In the first place, he says, the knife should not be over sharp, but should be a little dull, as if too sharp it will cut quickly through the wood and cut away the lead. If you remember, that is just the way a keen blade will use up a pencil. Then again, he says, it is best to hold the pencil in the left hand with the end to be sharpened pointing away from you and to cut away with a pushing cut, rather than toward you with a drawing cut, as when the point of the pencil is rested against the side of the thumb and is sharpened by a draw cut stroke of the knife blade.

Floating Civic Arts Building

AN interesting and thoroughly modern suggestion is given by a "sketch model of a proposed Civic Arts Building" at the exhibition of the Architectural League, 215 West Fifty-seventh Street. Made to scale it would be a circular building about 450 feet in diameter, with a well proportioned colonnade of early Doric type encircling it, and with a portico at the principal entrance.

This structure, rising abruptly from the water, suggests that the building occupies an island site, but it is in reality upon a buoyant concrete foundation. The foundation has the form of a great double walled bowl with ledges built in amphitheater form on the inner wall on which would be placed regular theater seats. The inner shell of the bowl is a segment of a sphere of smaller radius than the outer one and contacts with it at the lowest point. From this point a dozen or more vertical walls, connecting the two, radiate to the circumference, dividing the intervening space into as many watertight compartments.

This building is proposed as a desirable city enterprise for the maintenance of a civic theater, concert hall, arts and crafts schools, exhibitions and competitions, the discussion of civic public art and other matters—in a word the art and civic center of the people, to be moored at some such accessible point on the water front as Battery Park, where mooring privileges are controlled by the municipality.

The plan creates at no cost a site more desirable than $5,000,000 could secure.

It is the conception of Robert Paine, a sculptor of decided character and originality with a natural affinity for engineering activities, who has several other practical achievements to his credit, among which is the sculptor's pointing or enlarging machine.

Friction of Gas Flow in Pipes

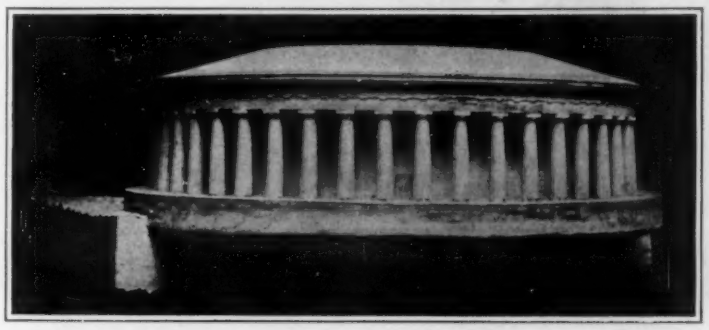
IT is not the intention of this article to impugn the accuracy of the formulæ of Weisbach, Rankine and others with regard to the friction of steam-flow in pipes; but whether through neglect of the principles laid down by these authorities, or through improper and unintelligent application of them, certain it is that there are to-day in what is called "successful operation" many power plants which show on careful analysis of steam-meter and other records a loss of power in the piping system which is truly appalling.

A striking illustration of the effects of pipe friction came recently to the writer's attention in the course of some experiments on a medium-sized vacuum cleaner, such as would be installed in the basement of a forty-room dormitory building. Several cleaners of rival makes were being considered, and as all operated on sweeping tests about equally well, it was determined to conduct accurate and thorough tests on each.

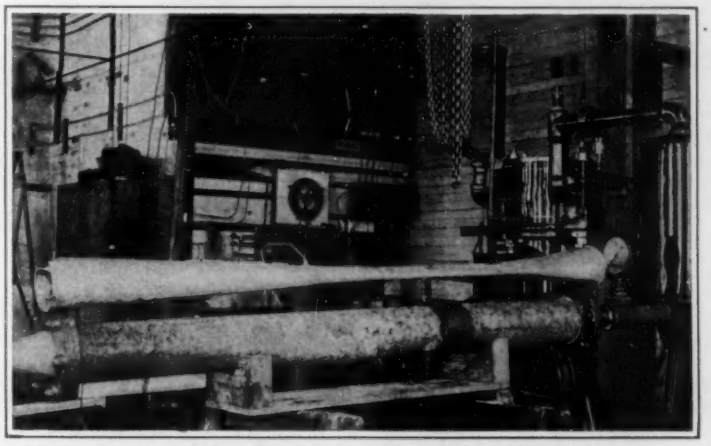
With this end in view, a tube of galvanized iron, No. 20 gage, ten feet long and of six inches internal diameter, was fitted at either end with a cone of the same metal, terminating in an opening of 1½-inch internal diameter. Measuring devices being fitted to the cylinder for determining the volume of air delivered to the machine, one of the cone ends was attached directly to the machine; and to the other was coupled ten feet of reinforced rubber suction hose of 1½-inch internal diameter. The end of this latter hose was open and fitted with a coupling to take the various sweeping tools.

The pump being started, the first run was made by detaching this suction hose from the cylinder, in order to get the free delivery volume, velocity, etc. The hose was then attached, with the intention of attaching the various tools to determine their resistance to the admission of air. The pump being again started, with the hose end open, the gage showed about five inches of vacuum when the tube suddenly and completely collapsed, as is shown in the photograph. The iron pipe on which the collapsed tube rests, was later substituted for the latter; and the general arrangements are clearly shown in the cut.

Proposed floating Civic Arts Building to be moored on the water front.

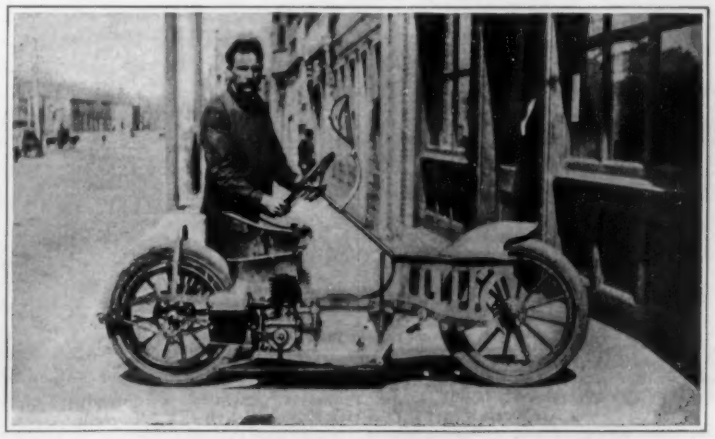


Rear of the building showing the bowl-shaped buoyant foundation.



Tin pipe collapsed by vacuum produced by friction of air.

Tractor leaving its trailer to be unloaded while it returns to the coal yard with an "empty."



A two-wheeled automobile.

The cause for the collapse of the tin tube could be nothing else than the creation of a vacuum within the cylinder because of the resistance of the ten feet of open hose, as the cylinder without the hose withstood the pressure without difficulty. Had the end of the hose been closed in part by the attachment of a sweeping tool, the result might have been expected. Further, this collapse was occasioned by the friction of air at comparatively low velocity. To how much greater degree, then, must friction be present in pipes through which steam is rushing at high velocity, and how especially pronounced must be this effect when it encounters a right-angle elbow?

The Three-wheeled Tractor

THE vital problem of satisfying the ever increasing demand for trucks of larger capacity has led to the advent of the three-axle tractor-trailer method of transportation in which all the propelling mechanism is carried entirely separate from the load-carrying portion. One of the important advantages of this method is the economy in tires and wear and tear of the mechanism. The major portion of the load is not carried on rubber tires, but on the steel shod wheels of the trailer, which saving alone would pay half the total expense of the largest truck.

A rear wheel drive machine has a tendency to push the front wheels down into the road surface, a front wheel drive pulls the rear wheels up and over. This difference in tendency is so marked that the same power plant, gear ratio and propelling mechanism will give far greater results in speed and pulling ability in a tractor than in a truck.

With a single tractor several trailers may be used, one being delivered while another is being loaded and a third being unloaded, thereby keeping the motor part active all the time; or, special unloading trailers may be used in some such lines as coal, ashes, garbage, etc., one dealer having delivered with a chute body ten loads of nine tons each to a distance of three miles, making the enormous total of 270 ton-miles for one day. A certain development company uses a twenty-yard trailer, receiving a 17 or 20-ton load from a chute and emptying by dumping, each operation taking less than a minute. Such large units are easily handled by using a single steering wheel. The wheel may be turned to at least 80 degrees, pivoting the unit at or near the fifth wheel, the entire vehicle being capable of turning around in a twenty-two foot street.

A Bicycle Automobile

A TWO-WHEEL automobile of unique design has recently been perfected by a western man, which differs greatly in its construction from a motorcycle, in fact, the two have little in common. It is like an ordinary automobile with the exception of the number of wheels.

There are two runners under the footboard, and when the operator releases his hold on the steering wheel, these runners automatically let down on the ground and keep the machine in an upright position. The wind shield is a small oval-shaped glass with a convex surface to the wind, large enough to protect the driver's face.

The radial frame, rear wheel suspension adds to the comfort of the passenger, while an entirely different system of springs is used on the front wheel. The steering knuckles not only turn the wheel, but shift the center of gravity, making easy steering.

The engine is 3-inch by 3-inch, two-cylinder, two-cycle, valveless type, of eight horse-power, and an excellent muffler makes silent running.

Although the photograph shows only a one-passenger car, it can be used for two persons by adding a seat over the rear wheel. This is a regular cushioned seat like the front one. One can also adjust a deck over the rear wheel and use the automobile for delivery purposes.

RECENTLY PATENTED INVENTIONS

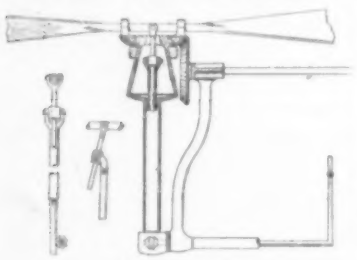
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAT.—J. HUTTER, care of Benj. Wertheimer & Co., 656 Broadway, N. Y., N. Y. The object here is to provide a structure which may be readily creased or folded without injury, whereby a hat may be trimmed while in an extended position, and then collapsed to take the finished position or the position desired.

Pertaining to Aviation.

FLYING MACHINE.—E. E. PORTER, 908 Realty Bldg., Charlotte, N. C. In this machine the turbine or aerial screw propeller is revolved either horizontally or vertically for the puposes of both supporting and propelling. The construction of the aerial screw propeller by which a single screw is made to do the sup-



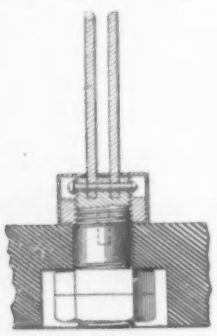
FLYING MACHINE.

porting and propelling consists in automatically oscillating the blades during each revolution, and decreasing the pitch in like amount on the opposite side, so that this form of screw has constantly a greater pitch and a greater pull on one side of its rotation than on the opposite side. The screw is thus unbalanced, and a sidewise thrust is exerted in addition to and at right angles to the normal thrust of the screw.

AEROPLANE.—H. W. ODLIN, care of Frank G. Burke, Jr., 336 W. 89th St., New York, N. Y. This invention provides an aeroplane arranged to automatically maintain its equilibrium and thus prevent capsizing in heavy winds, or when struck by sudden gusts of wind, and hence to insure easy riding and full utilization of the power employed for propelling the aeroplane.

Electrical Devices.

SWITCH JAW.—C. B. SCHOENMAN, 1318 Hunter St., Wilkinsburg, Pa. The principal object here is to provide a structure lessening the labor and material necessary heretofore in turning out switch jaws, the construction doing away with the necessity of the use of the more expensive copper and permitting the use

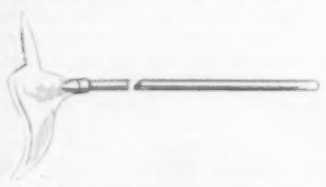


SWITCH JAW.

of other metals. The invention relates generally to structures used in electrical work, and more particularly to a jaw especially adapted for use with knife switches, fuses and the like.

Of Interest to Farmers.

IMPLEMENT FOR CUTTING AND HANDLING PEAR.—R. H. BROWN, P. O. Box 327, San Antonio, Tex. This invention pertains to implements for clearing the ground

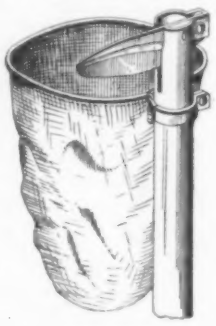


IMPLEMENT FOR CUTTING AND HANDLING PRICKLY PEAR.

for purposes of cultivation, the object being to provide an implement which may be easily and quickly handled for the purpose of cutting and handling prickly pear. Broadly, the improvement consists in the provision of an implement which embodies a handle and a transversely elongated head at one end of the handle, having an outer cutting edge and an engaging prong or tine extending from one side thereof.

BOLL WEEVIL CATCHER.—E. O. HUBBARD, Raymond, Miss. An object of this inventor is to provide a device for catching boll weevils, and for simultaneously cultivating the cotton plants; and further to provide a novel form of means for knocking the boll weevil from the cotton plants without injuring the latter.

FRUIT PICKER.—A. H. GELLNESS, Suttons Bay, Mich. In this invention the object is to provide a device for picking fruit which will prevent bruising of the fruit. A further object is to provide a device by means of which fruit



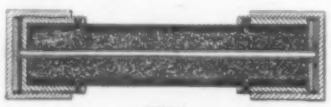
FRUIT PICKER.

in the highest part of the tree may be picked as well as that on the lowest. A further object of the inventor is to provide a device which can be manufactured cheaply for accomplishing the above named results.

Of General Interest.

ENVELOP.—W. F. CROWELL, 39 Wood St., Providence, R. I. The invention provides an envelop made from a sheet of paper of uniform width, thus saving paper material in the manufacture of the envelop, dispensing with the use of special dies to form the blanks, and allowing the formation of envelops of different sizes from a sheet of the same width.

FUSE.—J. H. PALMER, 506 Cedar Ave., N. S. Pittsburgh, Pa. This invention relates to fuses and has reference more particularly to a fuse comprising a shell, an insulated fusible conductor therein, and means whereby a conductor of a carrying capacity not exceeding a



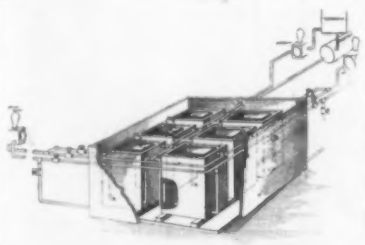
FUSE.

predetermined value can be introduced into the shell. An object is to provide an inexpensive, simple and durable fuse, in which the fusible conductor can be easily replaced by a new one of the same carrying capacity or one not exceeding a predeterminate carrying capacity.

CARD INDEX.—D. F. CARVER, 95 Liberty St., New York, N. Y. The main object of this invention is to provide cards with means whereby they will be caused to present themselves in single succession with adjacent cards so spaced apart at the upper edges that at least the heading of each card can be clearly read in succession. The operator is enabled to readily control the cards so as to cause them to be thrown forward in single succession toward the operator, each moving forwardly, separate and distinct from the one in front and the one behind it.

LENS SYSTEM.—R. D. GRAY, Ridgewood, N. J. This invention relates to photographic objectives, and the object is to provide a system more especially designed for use in objectives of telephotographic cameras, and arranged to overcome astigmatism, curved field, spherical and chromatic aberration and other defects, such as are frequently found in lenses used in apparatus of this class.

ICE MAKING APPARATUS.—S. R. BELL, 498 Walnut St., Beaumont, Tex. This invention has reference to ice making apparatus, and it has for its purpose the provision of one having combined means for making the ice

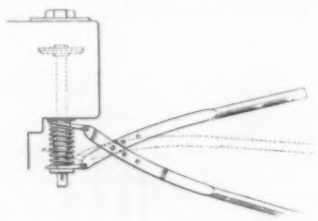


ICE MAKING APPARATUS.

and for cooling the brine, which is used in the ice making process, thereby dispensing with additional apparatus for cooling the brine. In this apparatus the ice is manufactured and the brine is cooled all in the same tank, which does away with a separate cooling tank for the brine found in other apparatus. The engraving is a perspective view partly in section, showing the ice-making apparatus.

Hardware and Tools.

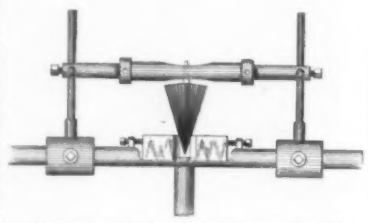
TOOL FOR COMPRESSING VALVE SPRINGS.—C. NYBERG, care of Summit & Downee, Huntington, N. Y. In this case the invention pertains to tools for compressing valve springs, and the aim is to provide one with two members, one being disposed in an elongated slot in the other, with means by which the two members may be readily pivoted together in adjusted position. Each of the members has a forked terminal disposed at an angle to the body of the member, and the members may be readily pivoted together with the



TOOL FOR COMPRESSING VALVE SPRINGS.

terminals converging or diverging, or, if desired, the members may be pivoted together with the terminals extended in the same direction and substantially parallel.

REAMER ATTACHMENT FOR DIE STOCKS.—H. BLOOMINGTON, 1609 O'Farrell St., San Francisco, Cal. The invention refers to a reamer attachment for die stocks, and has reference more particularly to a device which comprises an adjustable reamer supporting member adjustably supported on the die stock. The invention provides an inex-



REAMER ATTACHMENT FOR DIE STOCKS.

pensive tool which can be easily mounted on any die stock, and which will ream the interior extremity of a pipe, simultaneously with the threading of the same exteriorly. This improved tool will ream pipes of different sizes without changing the reamer secured thereto.

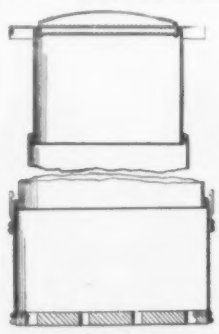
TOOL.—J. STURTEVANT and J. I. WEINZIERL, 1106 3rd Ave., New Kensington, Pa. This invention is more particularly intended for embodiment in detachable handles for cooking utensils, but is capable of embodiment in pliers and other gripping devices. A spring between the crossed handles of a pair of gripping jaws tends to close the jaws; a novel ratchet and spring pawl on the handles hold the jaws in closed position.

Heating and Lighting.

HEATER.—B. COLUMBUS, 696 E. 161st St., Bronx, N. Y. This improvement is in heaters applied to a gas fixture in a building to provide a ready and convenient source of heat for rooms and apartments; and it comprises features by means of which the stream of gas that is supplied to the heater is impeded upon entering the same, and more evenly distributed to the interior of the heater, so as to make the heating effect more efficient and more uniform in practice.

Household Utilities.

BED WARMER.—G. F. SHEPARD, P. O. Box 151, Dodge City, Kan. This invention provides a device by means of which heat may be stored from a suitable source of supply and transferred to the bed, warming the bed over an area corresponding to the position occupied by the person using the bed, and which while not in use may be stored in a small compass. The invention comprises a plurality of simi-



BED WARMER.

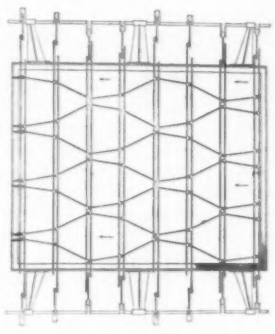
lar telescoping sections, a base to which the outermost section is secured, and a cover for the innermost section. The sections are cylindrical and gradually decrease in size from the outermost section 1 to the innermost section 5, in such manner that the sections fit within one another.

Machines and Mechanical Devices.

RAW STOCK DYEING MACHINE.—Z. E. NOAH, Denirn Station, Greensboro, N. C. This invention is an improvement in stock dyeing machines, and has for its object the provision of a machine that will take the stock and subject it to a plurality of operations, compressing it after each operation. The device is especially intended for indigo and raw stock.

WIRE STRIPPING MACHINE.—M. PESSIN, 624 E. 13th St., New York, N. Y. The object here is to provide a structure for removing one or more layers of insulation from any desired length of wire. Another object is to provide a structure which will straighten lengths of wire, sever the insulating matter thereon, and then remove the severed portions, each independent part of the insulation being removed to different receptacles.

SINUSOID PROPELLER.—I. J. PADDOCK, Nebraska City, Neb. This invention is based upon the fact that when a flexible surface, such as a sheet of fabric, is held at one edge in a current of air or other medium which is traveling in a direction parallel to the normal plane of the sheet, the latter will have imparted to it a series of wave-like motions.



SINUSOID PROPELLER.

These waves follow one another in rapid succession and have the form of a sine curve. Parts of the sheet will be moving upwardly, and other parts will be moving downwardly. An object is to provide a device by means of which the wave-like movements of the sheet may be used for generating power.

AUTOMATIC PUMP.—W. A. HARRIS, 217 John St., Greenville, S. C. This invention relates to improvements in automatic pumps, especially those that are designed to be operated by compressed air. It provides a pump for elevating water which will operate continuously while water is being drawn from a faucet or other outlet, but which will automatically stop after the faucet is closed.

Pertaining to Vehicles.

ATTACHMENT FOR BRAKES.—K. D. SAULPAW, Calhoun, Tenn. This improvement relates to attachments for brakes, and the object is to provide a brake block with two pivoted arms having teeth for engaging and holding the brake shoe in position. The brake block will last indefinitely, and the brake shoe may be readily replaced from time to time as required.

Designs.

DESIGN FOR A DRINKING GLASS.—C. GREER, New Castle, Pa. This ornamental design represents a glass of average elevation in height and curving inward from the top to the middle, thence swelling to the base in very graceful outline. The glass is very neatly embellished with ornamental patterns.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

We are prepared to render opinions as to validity or infringement of patents, or with regard to conflicts arising in trade-mark and unfair competition matters.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

MUNN & CO.,
Patent Attorneys,
361 Broadway,
New York, N. Y.

Branch Office:
625 F Street, N. W.,
Washington, D. C.

If you could take the roof off your factory

and let the sun shine into every corner, how much would the extra light be worth to you? It would reduce your lighting bills, increase the efficiency of your employees, enable you to utilize floor space now useless for fine work.

You can get a lot of extra daylight without taking off your roof. You can get an increase of 19 to 36 per cent. These figures are from the New York Electrical Testing Laboratories. They are the result of scientific tests of an interior paint which will not *absorb and waste the light* from your windows; which will *reflect every ray* down on your machinery and into the dark corners of your plant.

Rice's Mill White is the paint. It has increased the daylight in many plants. One prominent manufacturer writes that he estimates he is getting *50% more light than he had before he used it.* The R. J. Reynolds Tobacco Company say:

"*We have been too busy to make tests or determine with scientific accuracy the percentage of light increase in our plant afforded by the peculiar qualities of Rice's Mill White, but we imagine that such tests will show an increase of between 20% and 25%.*"

"*As you claimed, it picks up and carries along the light to those points at greatest distance from the windows and artificial lights. It has given us a smooth, tile-like surface of white, without a tinge of yellow, and it has remained firm and unbroken, despite the jar of heavy machinery.*"

A Sanitary Paint

Rice's Mill White gives a smooth, glossy, tile-like surface. It offers no lodgment for germs and odors, can easily be kept clean, and will not flake and scale like a cold water paint.

Rice's Mill White is economical to apply

A 4-inch brush spreads it without dragging and leaves no brush marks. Two coats equal three of lead and oil. Recoating is seldom needed, for it *stays white longer than any other gloss paint.*

We were the originators of "Mill White" paint. Rice's paint is made by a *special process*, which no other manufacturer can use.

For the greatest amount of light, the highest sanitary value and the lowest final cost, paint your ceilings and walls with Rice's Mill White Paint.

Rice's Mill White Paint is sold direct from our factory in barrels containing sufficient paint to cover 20,000 square feet one coat. If you have that area or more of ceiling and wall space to cover,

Write for Booklet and Sample Board

Ask for a copy of our booklet, "More Light." *Write today.*

U. S. Gutta Percha Paint Co.
No. 23 Dudley St., Providence, R. I.

RICE'S Granolith

A tough and elastic permanent finish for concrete walls. Becomes a part of the cement to which it is applied. One coat sufficient, unless a gloss is desired. Makes the best possible primer on inside concrete and brick for a second coat of Rice's Mill White Paint, giving a tile-like, enamel finish at no more expense than lead and oil paint.

For Concrete Surfaces

Our two-ton trucks used by the Pennsylvania Railroad

International Motor Trucks

Proved by Years of Successful Service

Mack 12 years in use **Saurer** 18 years in use **Hewitt** 10 years in use

Our two-ton trucks are being used to advantage as follows:

Bakers	Furniture Dealers	Public Service
Barbers' Sundries	Grocery Dealers	Publishing and Printing
Bottlers	Hardware Dealers	Railroads
Brewery	Hotel Service	Rubber Dealers
Builders	Ice Business	Sewing Machine Manufacturers
Butchers	Lead Business	Soap Dealers
Butter, Egg, Cheese	Liquor Dealers	Steel and Iron
Carpet Dealers and Manufacturers	Lumber Dealers	Stone and Bronze
Chemical Dealers	Machinery Mfrs	Storage and Warehouses
Coal Dealers	Meat Packers	Stove Manufacturers
Confectioners	Milk Trade	Telephone Service
Contractors	Millers	Textile Mfrs.
Department Stores	Mining	Tobacco Dealers
Dry Goods Dealers	Moving Pictures	Transportation and Trucking
Express	Municipal Service	U. S. Gov't Service
Fire Departments	Oil Dealers	Woodenware
Fish and Poultry	Paint Manufacturers	
Florists	Paper Manufacturers	
Fuel & Feed Dealers	Piano Manufacturers	
	Produce	

1. They are built with larger factors of safety *throughout* than any other trucks.
2. The yearly depreciation is only 10%.
3. Any truck will last a year—these trucks will give satisfactory and economical service for a long term of years.
4. They are well adapted to handling fragile freight — springs give adequate flexibility.
5. They can make the speed required for perishable freight, but "sprinting" is absolutely impossible.
6. No other two-ton truck is built in four sizes of wheel-base.

Whatever your transportation needs, we have the right truck for the purpose.

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(Concluded from page 202.)

when completed, forms the track upon which the forms for the rest of the lining travel. The forms are mounted on trucks with wheels tapered to fit the curve of the invert. The forms for the lower half cylinder are practically the same as those for the upper half cylinder. After the lining has set, the sides of the upper form may be drawn in to free them from the concrete, by operating the turnbuckles *A*, and those of the lower forms by operating the turnbuckles *B*. Then jacks may be unscrewed to lower the upper section slightly, freeing it completely from the concrete and jacks *E* may be screwed up to raise the bottom section slightly upon the truck. In this collapsed condition the forms may be drawn forward to complete the next section of tunnel. The detail view in the front page drawing shows how the lower forms are supported on the trucks. To the longitudinal beams *C*, vertical guides *D* are bolted, which fit against the framework of the truck. The jacks *E* mounted on the truck bear against cross pieces running from *C* to *C*. The filling of the lower half of the forms is comparatively simple. It is quite a different task, however, to lay the concrete into the upper form. Sections of the plating of the upper forms are removed and the concrete is shoveled in, adding the plates step by step as necessary, until finally the topmost plate is added when the concrete can be introduced only from the end of the form. It will be observed that small pieces of board are temporarily nailed against the edge of the forms and fitted up as neatly as possible against the rock above, so as to retain the concrete until it sets. As each section is completed, grouting holes are left in the top through which, when the lining is completed otherwise, grout will be forced under high pressure to fill up all cracks and crevices and make the lining perfectly sound.

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You have looked at many different makes of cars. You have found that in most respects they are very much alike. They have nearly the same specifications; the same equipment; the same general appearance—at least, while new.

You hear, in most salesrooms, the same talk about service, guarantee, taking care of owners.

And when it's all finished how are you to decide? Of all these *apparently* equal cars, sold by these *apparently* equal dealers, which one are you to select?

TO choose wisely you must remember that behind those apparently equal cars are unequal values. Behind these apparently equal dealers are unequal companies, unequal organizations, unequal factories. In these unseen things lies the difference between cars.

So you should look to these unseen factors. Study the cars of course. Insist that your car have all the modern features. But before you invest your money—whether you buy a Chalmers or not—be sure to get satisfactory answers to the following questions·

1. How long has the company been in business?

Is it a sound, well-managed institution? Has it demonstrated its ability to manufacture successfully? Is it progressive? Is it likely to be in business permanently? Is it big enough and strong enough to attract the best class of dealers?

The kind of car you get depends absolutely upon the kind of a company that is behind it. A strong, successful, well-managed company will not skimp in manufacturing. It will be able to afford experimental work, and thus keep always in the lead. It will be in position to back up its guarantee.

No company is more firmly established or better managed than the Chalmers. It has long been "first" in its class.

2. Does the company manufacture its own parts or merely assemble?

This is a vital question. The company that manufactures its own parts is able to put into the car *better value* for your money, because it eliminates the parts-maker's profits. It is able to manufacture more *accurately*, because it concentrates all its efforts on making parts for *one* kind of cars—its own. Also the company that makes its own parts will be able to give you service and supply your needs for years to come.

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Owners of a car are the people who know. They are the ones whose opinion is the result of experience—satisfactory or otherwise. Of course there is no car in the world—or any other manufactured product—that will earn the approval and endorsement of every single individual who uses it. But take the general opinion of the owners and you will make no mistake. Be guided by their opinion of car, company and dealer.

Chalmers owners are satisfied. We are glad to have you ask their opinion of Chalmers cars.

4. Has the car itself quality—or is it merely a collection of "features"?

Accessories and equipment that make for comfort and convenience enhance the value of a *real* car, but they cannot make up for any lack of actual quality in the car itself. Be sure that the car you buy has the real "class" and in-built quality that come only from painstaking workmanship all the way from designer's drawing board to the final inspection department.

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But greater than these tangible things, more valuable to you, more worth the money you invest are the intangible things behind the car—the Chalmers factory and the Chalmers organization. Other cars may give you approximately the same "features" as a Chalmers; none can give you these added values that make the Chalmers the choice of the wisest motorists.

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to a small stagnant lagoon. Thus, when the entire Catskill system is completed and operating at its full capacity, the waters which three days before poured out of the Ashokan reservoir in a mighty flood, over seventeen feet in diameter, will reach Staten Island, a stream only 3 per cent of its former size, after having been robbed by the rest of the thirsty city.

Friedmann's New Tuberculosis Remedy *

By H. J. Archard, M.D.

IT need hardly be said that Dr. Friedmann's remedy is not a serum, but a bacterin or vaccine, since it is prepared from tubercle bacilli. He admitted the origin of his tubercle bacilli (turtle) under pressure, but he refused and still refuses to communicate his method. Although he denies that his tubercle bacilli are originally human, he does not say how he obtained his turtle tubercle bacilli or how he infects the turtles. He denies that he uses the old strain of originally human turtle bacillus with which he worked in Piorkowsky's laboratory some years ago.

If we examine Friedmann's report, what do we find? In his original report, which was published in the *Berliner klinische Wochenschrift* for November 18th, 1912, he describes at length his clinical results in a great variety of tuberculous cases treated with his remedy, by intramuscular and intravenous injection, sometimes one or the other, sometimes both simultaneously. He asserts that patients show surprising improvement after one or two injections. He injects his bacterin into newborn infants, although it contains living tubercle bacilli, and says that somewhat over one year after this inoculation not the slightest trace of scrofula or tuberculosis is to be found in any of these children.

The account of animal experiments is extremely scant. Friedmann avers that his preparation is innocuous for guinea pigs, and that even after years they remain quite healthy. Nevertheless, they are not entirely immune to severe artificial infection; while his untreated animals succumb to this after about 110 days, guinea pigs immunized with one injection live an average of 363 days. He passes over this comparatively unfavorable result by declaring airily that, fortunately, conditions are much more favorable in man since tuberculous infection in human beings is never as severe as artificial infection in guinea pigs.

In the discussion before the *Berliner medizinische Gesellschaft*, which is one of the most searching, most severe, and mostly highly scientific tribunals before which a medical man can come, Friedmann's clinical results were confirmed by a number of clinicians, although Blaschko and also Heymann showed only indifferent results in cases of skin tuberculosis and lupus. Citron admits that for treatment and for prophylaxis the use of living germs is correct in principle and was adopted by Jenner and Pasteur, but he insists that great care must be exercised as long as the details of Friedmann's method are not known; he referred to Pasteur's experience with chicken cholera vaccine, in which the avirulent virus became virulent and caused destructive epidemics. He says: "As long as we do not know the nature of virulence, as long as we are not able to control virulence, but may be confronted at any time with the fact that an avirulent virus has become virulent for some unknown reason, so long we have all been afraid to employ this principle of living virus in man, however much we may agree in principle with Friedmann, that living virus should be employed."

Citron objects to the introduction of an unknown remedy which contains living virus into children who are not clinically tuberculous, although he can find an excuse for the administration of such a rem-

* Abstract of an address opening the discussion on the subject before the North Shore Branch of the Chicago Medical Society, February 4th, 1913.

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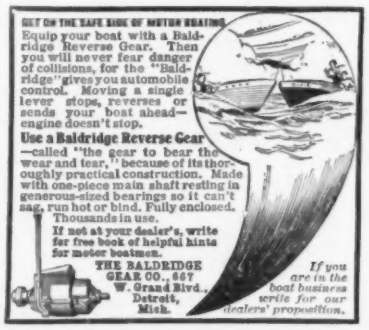

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edy as a last resort in severe tuberculous cases. He warns against the general use of the remedy until Friedmann has clearly stated of what his material consists. He refers to the relatively unfavorable animal experiments, which he calls failures.

Prof. Orth reports that the animal experiments did not yield absolutely good results. The immunized animals did not live much longer than the control animals. They all acquired tuberculosis.

Felix Klemperer's discussion, which was largely historical and along general lines, is immensely interesting, but it would lead too far to repeat it, even in abstract. He does not believe that *the* curative remedy against tuberculosis has been found, that tuberculosis has been practically eradicated, as was announced by one of the gentlemen in the discussion, but he insists that essential progress has been made. He shows the importance of the suppurative action of tuberculin, even of Friedmann's turtle tubercle bacilli, which had rendered earlier experiments at immunization futile. He asks how Friedmann's remedy has been deprived of this action of producing pus. Klemperer agrees with Citron that prophylactically, i. e., for the vaccination of children, the use of Friedmann's remedy is rather premature.

Goldscheider speaks from the point of view of the practitioner. He asserts that the purely clinical improvement which has been described in the cases treated is not sufficient, and demands documentary and far better proof than has yet been afforded of the actual benefit derived from the remedy.

In the further discussion, in which such men as Wolff-Eisner, Bier, and Goldberg took part, similar reasons were advanced for exercising great care and for waiting. Schwenk denied that a case of renal tuberculosis which Friedmann had declared to be cured had been improved; in fact he said that the disease was still progressive.

When we examine Friedmann's report in detail, we miss first of all the thoroughness and entering into essentials for which Koch's first account of the etiology of tuberculosis has given such a splendid example, and which was followed by other investigators, for instance by Ehrlich in the announcement of his salvarsan. Friedmann's account is not satisfactory and must be characterized as empirical far more than scientific. At the present day it no longer suffices to say that a remedy has cured or can cure tuberculosis. The cure must be established, first by a clinical improvement, which may be temporary only, and which as a matter of fact has been obtained by other remedies even better than could be done by Friedmann, and has been obtained in this country since 1897; then it must be shown that an actual immunity, demonstrable by laboratory tests, by the demonstration of specific antibodies, has been produced, and that this immunity persists for weeks, months, years. It does not appear that Friedmann has made even the simplest serum tests, those for agglutinins, although Koch had shown the way twelve years before and more, and although the behavior of the opsonic curve has been demonstrated conclusively to stand in positive relation to the clinical improvement and to the immunity acquired in the course of treatment.

Friedmann's *experimental* proof is pitifully insufficient to establish his contentions. The best he could show was that his experiment animals lived three or four times longer than the controls after virulent infection, while it has been shown with other remedies that experiment animals, notably guinea pigs, absolutely resist a virulent infection to which the controls succumbed in the course of a few months, and that the immunized animals were healthy and free from tuberculosis more than one year after infection.

Although, as pointed out by Citron and other men, the use of living tubercle bacilli is correct in the treatment of tuberculosis in principle, I maintain that the prophylactic use of such material in children and infants is little short of criminal. Friedmann has advanced nothing but his bare assertion that these living tubercle bacilli cannot change in their virulence and become harmful to the children. He can afford no guarantee that he has not infected these children and that eventually they may not acquire a fatal tuberculosis.

In spite of all the objections that may be raised against Friedmann's remedy, or rather against his administration of it at present, and against his incomplete announcement, I am free to admit that there may be, and probably is, a great deal of good in it. We certainly have clinical improvement in a great many cases, which has been confirmed by clinicians and by the physicians in charge. We have the disappearance of physical signs, the gain in weight, the restoration of the working ability, the loss of tubercle bacilli in the sputum, even the loss of a positive tuberculin reaction. The only question is, whether equally good results cannot be obtained with a less questionable, because less potentially dangerous remedy. This has been done.

Dr. von Ruck, in this country, has shown that it is not necessary to inject living tubercle bacilli for the purpose of successful immunization, but that a proper combination of the various extractives will accomplish this purpose with equal efficiency and certainly with far greater safety. He has even succeeded in removing the suppurative action of the tubercle bacilli by a proper balancing of the content in fats, or, perhaps better, by removing the excess of fats and waxes from the tubercle bacilli, which he had found to be responsible for abscess formation after hypodermic injection.

In children who are subjected to prophylactic inoculation with this remedy, which, *nota bene*, entails no risk, for it does not contain living tubercle bacilli, the most surprising clinical improvement was shown, especially a decided improvement in nutrition, a disappearance of all the clinical signs where they had existed, of lung signs, of enlarged lymph glands, of anemia, etc., and what is more significant, the sera of all these children showed a progressive increase in tuberculosis antibodies, agglutinins, amboceptor, opsonins. Further, they showed, and continue to show *lytic power*, the power to dissolve tubercle bacilli *in vitro*.

The New York Motor Boat Show

THE Motor Boat Show in Madison Square Garden this year was perhaps more than ever chiefly an exhibition of marine engines. There was also a goodly display of boats of various types, though the boats were not so numerous as heretofore. The cruisers were represented by two large 40-foot boats, the expensive pleasure craft by a 54-foot "Speedway de Visite," having a glass-inclosed cabin in the front and a commodious open cockpit in the rear, and the speedy runabouts and hydroplanes by a dozen or more boats ranging from 16 to 38 feet in length.

As heretofore, the cruisers are fitted with every convenience. On account of the high price of gasoline efforts are being made to reduce the fuel consumption to a minimum by means of economical carbureters, but there did not seem to be any tendency to use kerosene or crude oil.

The hydroplanes, of course, attracted the most attention, especially since they have almost completely taken the place of the displacement type of boat. Even that well known builder of steel boats, W. H. Mullins, has brought out a 16-foot hydroplane hull which, equipped with a 3-cylinder, 2-cycle motor of but 18 to 25 horsepower, is designed to travel at the rate of 28 statute miles an hour, and this all for a moderate price. An ordinary steel launch with inclosed motor in the cockpit can be bought for $300, it is claimed.

The hydroplanes were of all types—monoplanes, single-step, and multiple-step. The chief representatives of the second class were the "Baby Reliance II.," winner of one of the three races for the Harmsworth Cup last September, and a new hull, intended to be fitted with two 400 horse-power, 8-cylinder vertical mo-

Broadway, Norwich, Conn., Treated with "Tarvia B."

A Dustless Thoroughfare

"TARVIA B" is a tar product which is liquid at normal temperatures and can be applied to the surface of a macadam road from a modified sprinkling cart, no other apparatus being necessary.

The usual procedure is to sweep the road of surface dust and dirt, apply the Tarvia B and keep the traffic away for a few hours until the Tarvia has penetrated into the road surface. This grade of Tarvia is used only on roads where the rolling effect of traffic has made the interstices between the stones very small; on this account a denser grade of bitumen would not do, because it could not percolate into so closely bonded a surface. Tarvia B, however, finds its way into such surfaces and forms a matrix, holding the fine screenings in position, preventing raveling and erosion, preventing the formation of dust by automobile traffic and greatly prolonging the life of the roadway.

A typical instance of the use of Tarvia B is in Norwich, Conn. Mr. E. C. Lillibridge, the Street Commissioner there, wrote as follows:

November 15, 1912

"You ask for my opinion concerning Tarvia B, to which I will say I do not believe it has any equal. We have used this material for three years and the more it is used, the better satisfaction it gives, as to preserving the road and lasting longer. We have the last year used this material on two miles of streets and to-day those streets are in excellent condition after the traffic of heavy teams and autos."

In addition to Tarvia B there is Tarvia A for hot surface application and Tarvia X for road construction.

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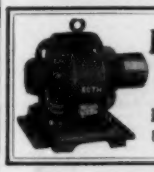

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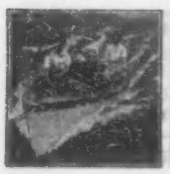

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tors driving twin screws. The multiple-step hydroplane advocated by William H. Fauber, was illustrated by 20-foot "Elco-planes" fitted with 150 horse-power and 60 horse-power 8-cylinder and 4-cylinder vertical engines, respectively. These boats have made 48.3 miles per hour and 35 miles per hour in tests on Newark Bay. Their bottoms are covered with sheet metal having small V-shaped corrugations running lengthwise of the hull, the V's being placed 5 or 6 inches apart. This corrugated metal covering is arranged in 4 and 5 low steps (about an inch) on the low-powered and high-powered boats, respectively. The hull in cross-section forms a wide open V throughout its entire length. Longitudinal slots are cut in the vertical sides between the bottom planking and the corrugated sheet metal to let in air and thus keep a vacuum, with its consequent drag, from being produced. The English boat, "Pioneer," which won the International races previously mentioned, was a 5-step Fauber hydroplane. Propelled by two 350 horse-power engines and twin screws she made 43.12 miles per hour in the race as against 42.73 miles per hour scored by the "Baby Reliance II." (fitted with a 150 to 180 horse-power Sterling 8-cylinder 5½ by 6¾-inch motor) in the race which this boat won.

The monoplane type of hydroplane hull in which there is no step, was illustrated by a huge 200 horse-power craft built for an Indianapolis sportsman. A distinctly novel monoplane hull was that of the "Viper V.," shown in the basement. This hull was just the reverse of the usual hydroplane in that the bottom was deeply concaved from the bow fully half way to the stern—so much so, in fact, that it is called a sea-sled since the sides form what might be called runners. The concavity decreases toward the rear, so that the stern is practically flat. Twin propellers are mounted on shafts projecting through the vertical stern planking just above the bottom of the boat. As only the lower half of the propellers are immersed, they are called "surface" propellers. Contrary to the general opinion that a semi-submerged propeller is only half as efficient as a totally submerged one, Mr. Albert Hickman, the designer of this new boat, claims that there is only from 6 to 9 per cent slip with surface propellers, while the drag of the shaft, strut, propeller boss, etc. (amounting in some cases to 40 per cent of the total resistance) is done away with. This boat has outwardly-swinging rudder plates hinged to each of its vertical sides. The engine is placed toward the stern instead of in the bow, and a generous cockpit is located forward. The concave shape of hull is said to be very seaworthy, and also to offer the advantage of trapping the air and forming an air cushion that materially reduces the pounding a hydroplane generally meets with. The results obtained with this boat are remarkable. A 25 horse-power motor weighing 400 pounds drove a 1,600-pound boat at over 26 miles per hour, while lifting 80 pounds per horse-power. This is about four times the efficiency shown by the ordinary hydroplane.

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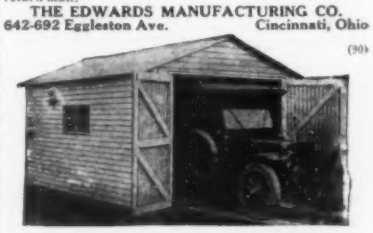

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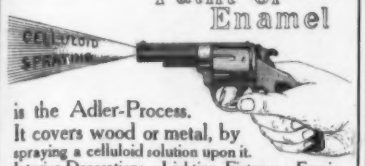

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published. Thanks, however, to the journalistic arrangements so admirably worked out in connection with this as with other recent polar enterprises, the salient facts are already before us.

The history of antarctic exploration up to date has comprised two stages. The first extended from the latter part of the eighteenth century to the early years of the twentieth. Some of its great names were Cook, Bellinghausen, Weddell, Balleny, Dumont d'Urville, Wilkes, Ross, Moore, Bruce, Chun, Borchgrevink, Gerlache, Arctowski, Drygalski, Nordenskjold, and Charcot. Chronologically this first stage overlaps the second, from which it is distinguished by the fact that its operations were confined almost entirely to the seas surrounding the antarctic continent. Many features of the continent itself were discovered, but nearly always from the decks of vessels, and in many of these discoveries there was a large element of conjecture.

The second stage really took its rise from the meeting of the Sixth International Geographical Congress in London, in 1895, when the dissatisfaction of geographers with the previous methods of antarctic research was crystallized in the decision that the actual exploration of the antarctic continent was the most urgent piece of work remaining to be done toward completing our knowledge of the earth's surface, and the means of accomplishing this desideratum were pointed out by Dr. von Neumayer, Sir Joseph Hooker, Sir John Murray, and Sir Clements Markham. While special emphasis was given to the work of land expeditions, the continuation of oceanographic research, as throwing important light upon the nature of the adjacent continent, was included in the programme, and the details of the task in hand were thus formulated by Murray:

1. To determine the nature and extent of the antarctic continent.
2. To penetrate into the interior.
3. To ascertain the nature and depth of the ice-cap.
4. To observe the character of the underlying rocks and the fossils.
5. To take magnetic and meteorological observations, both at sea and on land.
6. To observe the temperature of the ocean at all depths.
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To British science belongs the glory of having proved the feasibility and comparative facility of penetrating the ice-pack and actually landing parties of explorers on the antarctic continent; and practically all the land journeys in that quarter have been made by Britons, with the exception of Amundsen's. The abortive Japanese undertaking of a year ago hardly deserves mention in this connection, while Filchner's German expedition, expressly organized for the purpose of a long overland journey, appears to have accomplished little, if any, exploration on land, though the details of his travels, just completed, are still unknown.

The mere size of Antarctica ought to suggest to the practical reader a number of answers to his inevitable *cui bono?* concerning antarctic exploration in general. The continent of which Capt. Scott, in his first expedition, was the pioneer explorer, covers some five and one half million square miles of the earth's surface—about the area of Europe and Australia combined. A gap of this extent on our maps precludes any complete knowledge of the wind systems of the globe, of the distribution of the magnetic elements, of the main structural features of the earth's crust—in short of a host of fundamental matters the ultimate practical bearings of which ramify through our everyday life and affect the welfare of all mankind.

Before the new era in South Polar exploration, which Scott inaugurated, the continental character of Antarctica was altogether conjectural. It was hardly doubted that at some time in the remote past land had extended continuously from South America to Australia, a fact explaining the remarkable points of resemblance between the existing faunas of those two regions; but all that was known

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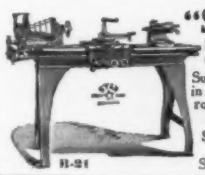
about the modern remains of this landmass could be explained as well on the assumption of an archipelago, masked under a load of ice, as upon that of a continent. In fact, up to a year ago there appeared to be strong reasons for believing that the so-called continent was cleft in twain by a broad channel connecting Ross and Weddell seas, and this belief was only conclusively disproved by the combined discoveries of Scott, Shackleton and Amundsen.

In this place only a hasty summary need be given of the work of Scott's two expeditions, which should be considered together, since the second was definitely planned as a supplement to the first. The first expedition entered Ross Sea, which all experience up to date indicates is the most practicable gateway to the interior, in January, 1902. The first task accomplished was the exploration of the Barrier edge from end to end. The Barrier was found to have receded some thirty miles since the days of Ross. A landing was made and a captive balloon sent up for the inspection of the interior. Next Scott discovered the high land bounding the Barrier to the east, and named it "King Edward VII. Land." At the other end of the Barrier he discovered that the volcanoes Erebus and Terror are on an island (Ross Island), and the volcanic formations here were thoroughly studied. The great achievement of this expedition, however, was the exploration of the huge range of mountains extending south from Cape Adair, and of the ice plateau lying west of them. During the first season Scott made a sledge journey due south, parallel to the Victorian range, to a point nearly three hundred miles nearer the pole than any one had gone before. During the second he traveled westward, scaling the mountains by the Ferrar Glacier and advancing over the inland ice one hundred and sixty miles. The magnetic observations made on this journey fixed the location of the magnetic pole, afterward actually reached by members of Shackleton's expedition. During the two years the party made splendid series of meteorological, magnetic, pendulum, tidal, and biological observations.

The second expedition, which sailed in the autumn of 1910, was, with the possible exception of Filchner's, the strongest scientific expedition that ever entered the Polar regions. Shackleton, a member of the first expedition, had in the meantime returned to the Antarctic on his own account, made further explorations from Scott's old base, and pushed over the Beardmore Glacier to a new and sensational "farthest south" in the very heart of the continent. Scott's original plan in his second enterprise was to distribute the activities of his large and able staff in four principal directions; an eastern party was to explore King Edward Land; a western party the Victorian range west of McMurdo Sound; a party was to remain at headquarters to carry out elaborate scientific observations; and a southern party, headed by Scott himself, was to proceed, if possible, to the Pole, in order, Sir Clements Markham would have us believe, to make magnetic observations, "the only practical reason for going there." His expedition as a whole carried out a programme of scientific research as thorough as the most conservative mentors of the enterprise at home could have desired. Some changes in the plans had to be made. The eastern party, under Lieut. Campbell, was unable to land on King Edward Land, and proceeded instead to Cape Adair, thus becoming the "northern" party. After a year of exploration in that region they were picked up by the expedition ship, the "Terra Nova," and set ashore again at Terra Nova Bay, for a short sledge journey. The ship was, however, unable to take them off, on account of impassable ice, and with very meager stores and only a summer outfit they were obliged to improvise winter quarters in a snowbank, ultimately making their way 200 miles overland to the expedition's base at Cape Evans.

The western party carried out geological work on an extensive scale, and dis-



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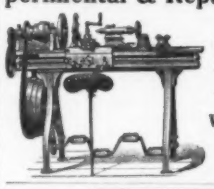

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covered, among other things, a deposit of bituminous coal, evidence that a temperate climate must have once prevailed in this region. They also found thousands of wingless insects, of two species. The party at headquarters made very thorough meteorological and magnetic observations. A magnetic observatory was excavated in the side of a glacier, to secure uniform temperature throughout the year. The physical work was carried out by Dr. George Simpson, of the Indian Meteorological Department, who is a specialist in atmospheric electricity. Dr. Simpson returned to England last summer, and at a meeting of the Royal Meteorological Society announced some very interesting discoveries in meteorological optics made during his southern sojourn. Upper-air soundings were made with balloons to a height of six miles. A bold feat carried out in mid-winter by Wilson, Bowers and Garrard consisted of a five weeks' journey across the Barrier to study the incubation of the emperor penguins, which breed in winter.

The suggestion made some months ago by Mr. E. S. Balch, in the Bulletin of the American Geographical Society, that Scott had chosen the meteorologically worst side of the Barrier for his inland route has been tragically confirmed. The furious blizzards for which the whole periphery of the Antarctic continent is notorious, sometimes attaining a force of 70 or 80 miles an hour, appear to be the result of air drainage down the slopes of the vast ice-cap of the interior. In accordance with a well known law, they are deflected to the left by the rotation of the earth. Thus the furious blizzards of the Barrier are mainly from the southeast, and a glance at the map shows that Scott must have experienced the full brunt of them, to say nothing of the fact that they delayed his departure from his base to a dangerously late period in the season. Amundsen's route, and especially the location of his base, was far more favorable with respect to these winds—and a comparison between his and Scott's experiences affords a striking lesson in antarctic meteorology. However, this comparison does not indicate better judgment on the part of the Norwegian explorer, for his easterly route was chosen solely to avoid trespassing upon territory preëmpted by another.

A comparison between Scott's and Amundsen's methods of travel lies beyond the scope of the present article, but the writer may perhaps be pardoned for suggesting that Scott's preference for human as compared with other modes of traction seems the height of quixotism.

The Heavens in March

(*Concluded from page 208*)

Taurus, setting after 11 P. M. Uranus is in Capricornus, rising about 4 A. M. Neptune is in Gemini, and sets at about 3 A. M.

The Moon is new at 7 P. M. on the 7th, in her first quarter at 4 P. M. on the 15th, full at 7 A. M. on the 22d, and in her last quarter at 8 A. M. on the 29th. She is nearest us on the 21st, and farthest away on the 6th. As she completes her circuit of the heavens, she passes by Jupiter on the 2d, Mars and Uranus on the 4th. Mercury on the 9th, Venus on the 11th, Saturn on the 13th, Neptune on the 17th, Jupiter again on the 29th, and Uranus on the 31st.

At the time of full Moon on the 22d, there is a total lunar eclipse. The earlier phases of this are visible in the eastern part of the United States, and the whole eclipse on the Pacific Coast. The Moon goes almost centrally through the Earth's shadow, and totality lasts more than an hour and a half. According to Eastern standard time, the first contact of the Moon with the shadow comes at 5:13 A. M.; totality lasts from 6:11 to 7:44; and the Moon leaves the shadow at 8:43. Only the beginning of the eclipse can be seen from Washington; but from points on the Pacific Coast, by whose time all the phases occur three hours earlier, the whole eclipse can be observed.

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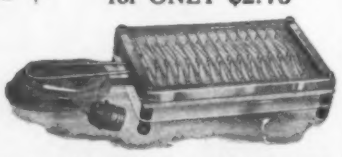

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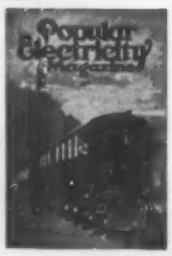

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(12753) C. W. B. writes: In reference to query 12741, please allow me to suggest that there are no hatcheries in the clouds for breeding angle worms, toads or frogs. Angle worms breed and live in the ground, and they are so secure there that no wind is sufficient to suck them out and up to the clouds. But as their enemies, the birds, prey on them during the daytime, they have become night workers, and parade mostly in the night, and especially during warm rains. The worms P. S. F. saw came out during the "several hours of rain," but a sudden change to snow stiffened them so they could not get back into their holes. They struggled for life and kept on top of the accumulating snow, but at last froze to death where he found them. Of course, everybody knows that toads and frogs breed in water. As soon as they have developed from tadpoles, they generally change their dwelling place from water to land during a warm rain in spring and early summer. Their sudden appearance at such times has developed the popular fallacy that they have rained down! Now, are not these "common sense" explanations, and also in accordance with scientific knowledge? A. There can be no doubt of the common sense character of C. W. B.'s explanation of the phenomenon in question. Nor is there any doubt that in certain storms there is an upward current sufficient to raise small articles and carry them long distances before they drop out of the whirl. Waldo's "Elementary Meteorology," page 248, states that "large rain drops 0.1 inch in diameter require an upward current of only 16.5 miles per hour to sustain them when the air pressure is 23 inches; while small rain drops require an air current of only 3 miles per hour to prevent their falling to the ground." Also, "In case the ascending current in a tornado had a velocity of 100 miles per hour, where the pressure of the air is 15 inches, this would prevent a hail stone 2.5 inches in diameter from falling to the ground." These ascending currents exist in all violent storms, and in ordinary storms to a lesser degree. Any particular instance must be determined by the circumstances of that particular instance, and cannot be determined by any general belief in the possibility or impossibility of the carrying up and dropping of small things from the clouds. We grant that this explanation should have been given in the former note, so that the meaning might have been clear. Our meaning was this: Whether small worms were carried up in the particular instance must be determined by a knowledge of the force and character of the storm in question, conditions which we did not know. The only condition we intended to state was the possibility of such an occurrence with a sufficient rotary motion of the storm.

(12754) J. C. D. asks: Please explain in non-technical language how the Chinese use the Chinese abacus to count. And why other nations do not use it. A. The Chinese abacus is simply a counting board, on which the results of computations done in the head are tallied, as it were. It is a shallow box divided lengthwise by a bar, and having several wires crossing the box and passing through the bar. On one side of the bar are five balls, and on the other side there are two balls. The five balls stand for units, and the two balls stand for five each, or ten taken together. When the five balls on one wire have been tallied, one of the two balls is pushed up, the five balls are pushed back, and the tally proceeds till another five has been tallied when one on the next wire is pushed up and this ten (or two fives) is pushed down. Any wire may be taken as units. Those to the left will be tens, hundreds, etc.; those to the right of this will be tenths, hundredths, etc. Simple tallying of calculations is done on the abacus with rapidity, but if a mistake is made it cannot be detected. The work must be gone through again. A similar instrument was employed in ancient times by the Romans, but modern nations find paper and pencil a better way to perform their reckoning.

(12755) H. J. S. writes: Recognized as the only authority, I seek information. Is it necessary for one to stand on *all* three rails of a third-rail system in order to get a shock? Are not the two running rails connected as one arm of a current, with the third rail as the other? Is it not possible to stand on the third rail and one of the running rails and receive a shock? Also in rain, through a short circuiting, cannot one receive a shock standing on the third rail alone? A. In a third-rail system the two rails which carry the cars are in connection with the earth, and cannot give any shock by themselves. The current comes by the third rail from the power house, and the third rail is charged to full voltage all the time. Standing on the ground or on one of the rails of the track, you will certainly receive a severe shock by touching the third rail. Standing on the third rail alone, no shock would be felt, since there is no way for the electricity to escape from you to the earth. If you step off, you will receive a shock when you put one foot upon the ground, the other being on the third rail.

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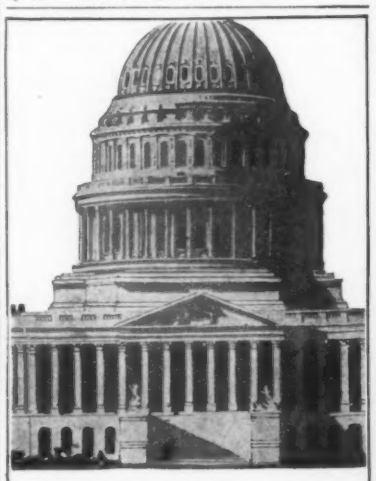

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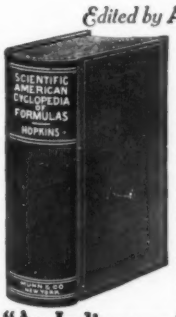

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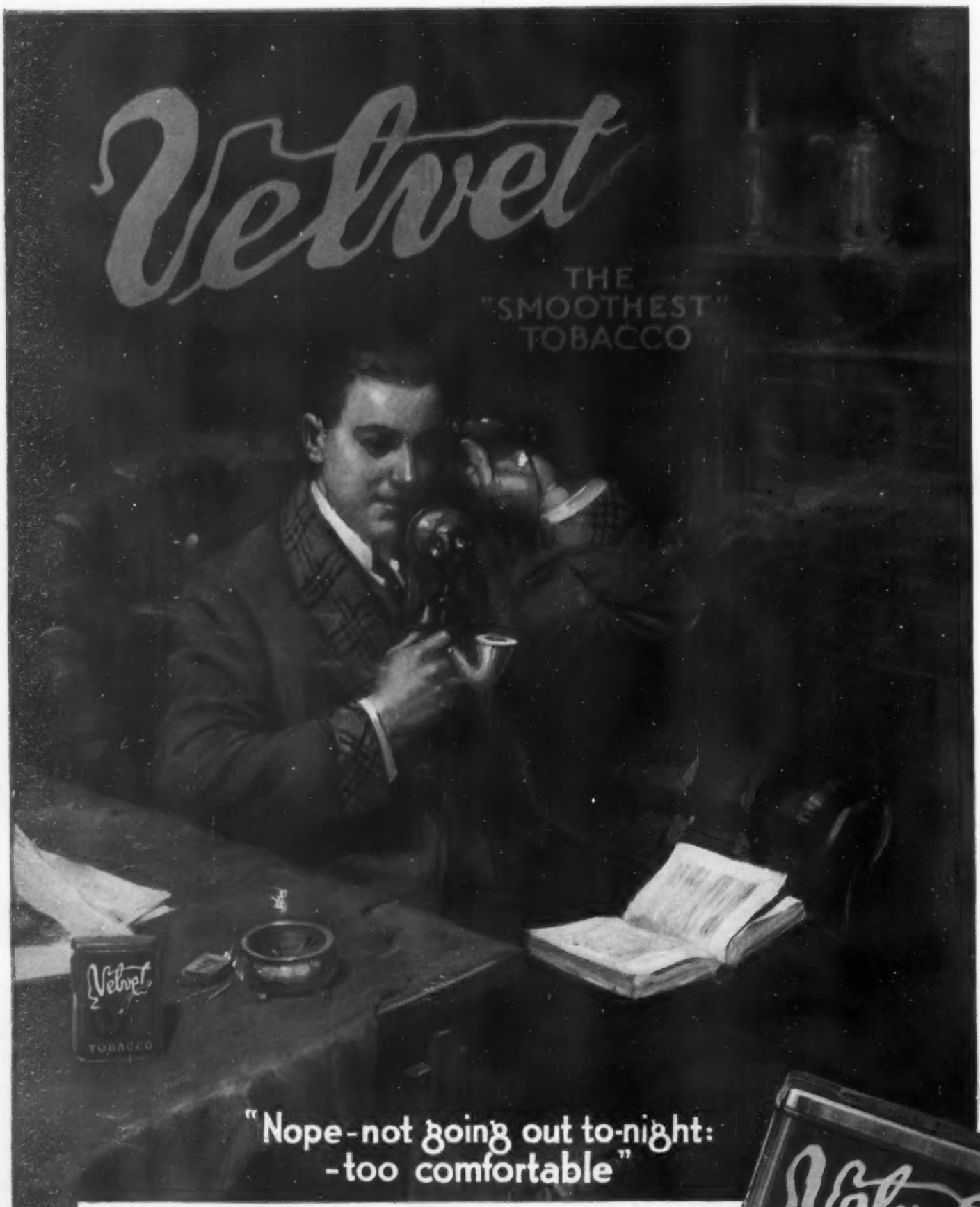

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